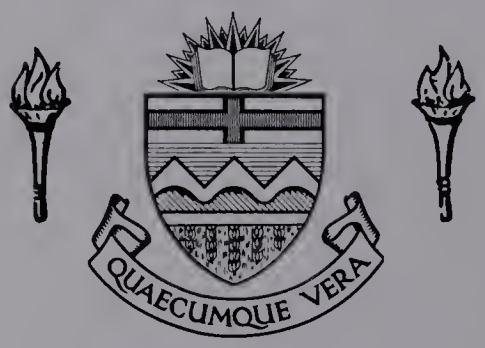

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THE EFFECTIVENESS OF THE ILLINOIS TEST OF PSYCHOLINGUISTIC ABILITIES IN PREDICTING READING ACHIEVEMENT

BY

OREST JOHN HAMALUK

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

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FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "The Effectiveness of the Illinois Test of Psycholinguistic Abilities in Predicting Reading Achievement," submitted by Orest John Hamaluk in partial fulfillment of the requirements for the Degree of Master of Education.

August, 1967

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ABSTRACT

The purpose of this study was to investigate the effectiveness of the various individual subtest scores, the total test score, and various theoretical groupings of subtest scores of the Illinois Test of Psycholinguistic Abilities in predicting reading achievement at the end of the first grade.

To test the hypothesis, a sample of thirty school beginning pupils were randomly selected from the pupils in six schools believed to be representative of the Edmonton Public School District. The Illinois Test of Psycholinguistic Abilities (I.T.P.A.) was administered to the pupils in the sample at the start of the school term. The Gates Primary Reading Tests were administered to the pupils in the sample eight months later. A step-wise multiple linear regression analysis of the data was carried out.

Since reading achievement is known to correlate with other variables such as I.Q., socio-economic status, and mental age, a step-wise multiple linear regression analysis of the I.T.P.A. scores as a function of these factors was also carried out to determine the relationship of achievement on the I.T.P.A. to these variables. Various combinations of I.Q., mental age, and socio-economic status were found to be significant predictors of achievement on the various subtests of the I.T.P.A. Therefore, it was decided to carry out a second step-wise multiple linear regression analysis of reading achievement with these variables included in the context of I.T.P.A. scores as predictors.

Analysis of the data indicated that five of the nine subtests were significant predictors of reading achievement. The ranked order of predictors is visual-motor sequential, auditory-vocal sequential, auditory-vocal automatic, visual-motor association and visual decoding. Visual-motor sequential consistently accounted for approximately one half of the variance of prediction. Visual-motor association was negatively weighted, indicating that the first three tests were also measuring a variable which is not directly involved in the reading process.

Inclusion of the total I.T.P.A. score, and scores of various theoretical groupings of subtests with the subtest scores as predictors was found to leave the ranked order of predictors unchanged. The total I.T.P.A. score and scores of various theoretical groupings of subtests were found to be redundant and did not contribute to the effectiveness of the I.T.P.A. as a predictor of reading achievement.

Analysis of the data when I.Q., socio-economic status, and mental age scores were included in the context of the subtest scores of the I.T.P.A. as predictors of reading achievement revealed the previous ranked order of predictors to be substantially altered. The ranked order remained approximately the same for predicting achievement on the word recognition test. However, in predicting sentence reading, paragraph reading and total reading scores, I.Q. ranked second as a predictor. The visual-motor sequential subtest score still ranked first, and accounted for approximately one half of the variance of prediction.

An examination of the subtests of the I.T.P.A. indicated that each subtest appeared to be measuring several variables. Therefore, it was concluded that even though five of the nine subtest scores predict reading achievement at the end of first grade, use of the I.T.P.A. as a predictor of reading achievement, or as a guide to training activities for children is not recommended.

It was further speculated that the visual-motor sequential test may be measuring a complex spatial ability factor. Further research was suggested to investigate the relationship of the various aspects of this spatial ability to reading achievement, and to determine the relationship of the several variables measured by the auditory-vocal sequential subtest to reading achievement.

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THE PROBLEM

INTRODUCTION TO THE PROBLEM AND NEED FOR THE STUDY

Reading may be considered a communication act made up of psycholinguistic processes; that is, psychological processes are brought to bear on language, the medium of communication, as represented in print.

Kirk[1] and Dechant[2] point out that reading is a communication process which includes reception, perception, interpretation of stimuli, and response to the interpretation.

Spencer[3] stresses that reading of any stimuli is basically a native or innate behaviorial process involving the receptors, central nervous system, and expressors. Basically, the process is one of making discriminative responses to stimuli. Reading of print differs from reading of any other stimuli in the form and degree of abstractness of stimuli perceived.

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[1]S. A. Kirk, The Diagnosis and Remediation of Psycholinguistic Disability (Urbana, Illinois: University of Illinois Press, 1966), p. 15.

[2]E. V. Dechant, Improving the Teaching of Reading (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1964), p. 89.

[3]P. L. Spencer, "Reading as Concept Building," 17th Yearbook, Claremont College Reading Conference (1952), 19.

Dechant[4] points out the symbolic nature of the stimuli in reading when he refers to reading as a communication process which utilizes symbols on the printed page. Language, the medium of communication, is the symbolization of experience. The printed word is a representation of speech sounds. Loban's[5] study demonstrates the relationship of language ability and reading ability. He found that those who are high in general language ability are also high in reading ability. Those who were low in general language ability were also low in reading ability.

Carroll points out the psycholinguistic nature of reading when he analyzes reading into language and the comprehension of language. He states:

> The behavior we call reading may be described as the perception and comprehension of written messages in a manner paralleling that of the corresponding spoken message.[6]

Kirk[7] also considers reading to be a psycholinguistic process.

McCarthy of the University of Wisconsin, and Kirk, of the University of Illinois have developed the Illinois Test of Psycholinguistic Abilities (I.T.P.A.) which purports to assess psycholinguistic processes involved in communication. The test consists

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[4]Dechant, loc. cit.

[5]W. D. Loban, The Language of Elementary School Children (National Council of Teachers of English, Research Report No. 1. Champaign, Illinois, 1963), p. 85.

[6]J. B. Carroll, "The Analysis of Reading Instruction: Perspectives from Psychology and Linguistics," Theories of Learning and Instruction, 68th Yearbook of the National Society for the Study of Education, Part I (1964), p. 337.

[7]Kirk, loc. cit.

of nine subtests which attempt to assess the processes, levels of organization, and channels involved in communication. It has been standardized for children from age two years, six months to nine years of age.

As will be shown later, there is resemblance between the psycholinguistic processes tested by the I.T.P.A. and those processes constituting successful reading performance and used in reading readiness tests to predict reading achievement.

Since reading has been described as a communications act involving psycholinguistic processes, and there is some evidence that the processes measured by the I.T.P.A. are related to, and can predict reading achievement, there is need to determine the effectiveness of the Illinois Test of Psycholinguistic Abilities in predicting reading achievement at the end of the first grade.

If a significant relationship is found to exist between the processes tested by the I.T.P.A. and reading achievement, then the I.T.P.A. may be used as a predictor of successful reading achievement. Furtheremore, this study may help gain additional insight into the reading process.

PURPOSE OF THIS STUDY

The purpose of this study was to determine the ability of the I.T.P.A. total score, the individual subtest scores, and groups of subtest scores to predict reading achievement as measured at the end of the first grade by the Gates Primary Reading Tests. By

administering the I.T.P.A. in September to students entering grade one and the Gates Primary Reading Tests in May to the same students, the predictive validity of the I.T.P.A. was tested.

HYPOTHESES

The following hypotheses were tested in this study:

1. The individual subtest scores of the Illinois Test of Psycholinguistic Abilities in the context of all such subtest scores do not account for a significant part of the variance attributed to the scores of the three subtests and the total score of the Gates Primary Reading Test.
2. The total score of the Illinois Test of Psycholinguistic Abilities in the context of the subtest scores and the total score of the Illinois Test of Psycholinguistic Abilities does not account for a significant part of the variance attributed to the scores of the three subtests and the total score of the Gates Primary Reading Test.
3. The scores of theoretical groupings of subtests of the Illinois Test of Psycholinguistic Abilities in the context of such groupings plus individual subtest scores do not account for a significant part of the variance attributed to the score of the three subtests and the total score of the Gates Primary Reading Test.

DEFINITION OF TERMS

The following terms are used in this study to represent processes which are highly integrated, therefore reference to each as unitary and isolated is somewhat arbitrary.

Recoding, decoding, interpretation and encoding as overlapping processes constitute one way of considering the reading act. Association and intention are rather pervasive accompaniments of the whole process.

For purposes of this study, the following terms are defined:

Recoding is a process, largely sensory in nature, whereby data from one modality are converted into data for another modality. Visual data, where reading is involved, may be recoded, or translated into their sound equivalents before the words as sounds are given the meaning attributed to them.

However, recoding may be part of the perceptual process designated as decoding. That is, recoding and decoding as processes are inseparable. The degree of overlapping of the two processes probably depends at least partly upon the skill and purpose of the reader, and the difficulty of the material being read.

Decoding is a process, largely perceptual in nature, whereby meaning is given to sensory data. As stated previously, decoding and recoding as processes may not be readily distinguishable from each other. However, as concepts, the two terms are useful in a consideration of reading.

Association. English and English define association as:

> A functional relationship between psychological phenomena established in the course of individual experience and of such nature that the presence of one tends to evoke the other.[8]

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[8] H. B. English and A. V. English, A Comprehensive Dictionary of Psychological and Psychoanalytical Terms (New York: Longmans, Green and Co., 1958), p. 44.

Association, therefore, probably occurs throughout the perception-response process. In reading, it occurs whenever meaning is attached to graphic or oral symbols, when further interpreting this meaning in terms of other past experience relevant to the context of the message, and in responding to these different meanings.

Interpretation is the process through which the decoded message is given an expanded meaning by association of the decoded message with other experience relevant to the context of the message. Interpretation occurs in reading when the reader goes beyond the information given in print. He may, for example, determine the consequences of what was given in print. When a child reads a statement such as "The Eskimo depends upon game animals for food," he must interpret this statement to expand its meaning before he can correctly respond to a question such as "When does the Eskimo go hungry?"

Intention is the tendency to respond to a stimulus in a specific manner. In the reading process, intention is probably built from the moment the visual sensations related to print are first received. The intention may best become fully operational after interpreted meaning has been attached to print, but may be operational earlier.

Encoding is the process whereby intentions are carried out. If the intention for example is the tendency to point to a specific object, encoding is the organization of the motor act and the motor act through which this is done. Encoding probably begins at the time the intention becomes operational.

Sequencing is the process of remembering a string of visual or auditory stimuli in the order in which they were presented.

Channel of Communication is the combination of the sense modalities and response modalities through which sensory data is received and the response is made. For example, one such reading act may involve the visual-motor channel when a child makes the motor response that a statement he read instructed him to make.

Level of Organization is the degree of conscious control which is exercised on the perception-response process by the organism. At the lowest level, called the projection level, the sensory data are processed and responded to without any conscious control by the organism. This level is unmodifiable by learning, and is the level at which reflex actions are organized. The projection level is actively involved in the sensory process of reading.

At a higher level called the automatic-sequential level, a sequence of sensory data is perceived and reacted to in a relatively automatic way. Highly overlearned acts which no longer require conscious control are organized at this level. Reading from left to right along a line of print, or processing the language according to an intuitive grammar of the language are examples of this level functioning in reading.

At the highest level, called the representational level, conscious control of the perception-response process is exercised. This is the level at which sensory data is given its fullest meaning, and at which cognitive processes such as problem solving, and organizing a response occur.

Psycholinguistic Abilities are the processes of recoding, sequencing, decoding, interpretation, and encoding, occurring at the different levels of organization, and through the various channels of communication.

Reading as a Communication Act is the reception and perception of sensory data, interpretation of the perceived data in terms of past experience, and terminal response to the interpreted data.

ASSUMPTIONS

For the purposes of this study, the following assumptions are made:

1. The theory of perception and language as cognitive phenomena as postulated by C.E. Osgood,[9] which was the model for the development of the I.T.P.A., is a tenable theory.

2. The I.T.P.A. accurately reflects Osgood's theory.

3. The battery of Gates Reading Tests used to measure reading achievement accurately reflect the reading process.

The results of this study may require that these assumptions be re-evaluated.

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[9]C.E. Osgood,"A Behaviorist Analysis of Perception and Language as Cognitive Phenomena," Contemporary Approaches to Cognition (Cambridge, Mass.: Harvard University Press, 1957), pp. 75-118.

PROCEDURES USED IN REPORTING THE STUDY

The description of the present study will be developed as follows:

Chapter II Background for the Study

Chapter III Related Research

Chapter IV The Experimental Design

Chapter V Analysis and Interpretation of Data

Chapter VI Summary, Conclusions, Implications and Recommendations.

CHAPTER II

BACKGROUND FOR THE STUDY

This chapter presents the background for the study by first describing the reading process as it is generally described by authorities in reading. Then reading as a communication act involving psycholinguistic processes is described. This is followed by a description of the Gates Reading Test, and the Illinois Test of Psycholinguistic Abilities, the two test instruments used in this study. Lastly, the equivalence and differences between the Illinois Test of Psycholinguistic Abilities, the Gates Reading Tests and the reading process are described.

THE READING PROCESS

The reading process can be described as consisting of sensory reception, perception, interpretation, and responses.

Smith and Dechant[10] describe the initial stage of reading as a sensory process influenced by the perceptual process. The sensory process primarily involves the reception of stimuli, and changing this stimuli into neural impulses which are handled by the central nervous system. This process is unmodifiable by learning. The perceptual process influences the sensory process by organizing sensory data and directing the sensors to specific stimuli.

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[10] H. P. Smith and E. V. Dechant, Psychology in Teaching Reading (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1961), p. 437.

The perceptual aspect of reading has been described by Gray[11] as involving discrimination, association and arousal of meaning. The beginning reader must discriminate the characteristics of the graphic pattern, and associate them with their sound equivalents. The sound equivalent, which has meaning established through prior experience, arouses this meaning for the graphic pattern. This is word recognition in reading.

As the reader's skill develops, the process of associating sound with symbol may no longer be overtly done. As reading skill is developed the amount of the graphic pattern understood generally increases to include phrases and even sentences; as well, the reader probably becomes more skillful in his use of smaller units, such as individual letters and parts of letters, as cues.

Gray[12] describes the next stage in the reading process as three levels of comprehension.

The first level is described as a clear grasp of the literal meaning of the passage. This requires grasping the literal meaning of each sentence and organizing the ideas of the sentences into a literal meaning of the whole passage.

The second level of comprehension is described as the fuller and more penetrating grasp of meaning intended by the author. This is

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[11] W. S. Gray, "The Major Aspects of Reading," Sequential Development of Reading Abilities, Supplementary Educational Monograph No. 90 (University of Chicago, Illinois Press, 1960), pp. 8-25.

[12] Ibid.

achieved by the flow of ideas stimulated by, but not limited to the printed word. By relating his own experiences to the literal meaning of the passage, the reader goes beyond the literal meaning and interprets it in terms of his own experiences. The reader thus gives an expanded meaning to the passage.

Gray[13] describes the third level of comprehension as grasping the significance and implications of the author's ideas. This results from the literal and expanded meaning given to the passage, and may require much reflection and study apart from the passage. Gray acknowledges that some may object to calling this a part of the reading process, but if we consider it as critical reading, then this third level of comprehension is viable.

Gates[14] claims that comprehension can and should embrace all types of thinking, evaluating, judging, imagining, reasoning, and problem solving. He, therefore, supports Gray's third level of comprehension.

Gray[15] also points out that an important aspect of the reading process is the assimilation of ideas by fusion of new ideas acquired through reading with previous experience. This is the goal of reading.

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[13] Ibid.

[14] A. I. Gates, "The Nature of the Reading Process," Reading in the Elementary School, 48th Yearbook, Part II (N.S.S.E., 1949), p. 3.

[15] Gray, loc. cit.

Spencer[16] and Gates[17] state that the reading act is completed when the reader responds to what he reads. The response may be in the form of oral expression of ideas or other overt acts. McCreary and Surkan,[18] however, suggest that the response may not be observable, but may be the placement of the ideas in memory. An overt response enables an observer to evaluate the extent of comprehension and assimilation of ideas, but either an overt or covert response becomes feed-back to the reader to indicate whether he gave the passage the meaning intended by the author.

READING AS A COMMUNICATION ACT INVOLVING PSYCHOLINGUISTIC PROCESSES

Reading as a communication act involving psycholinguistic processes consists of sensory reception, recoding, sequencing, decoding, interpretation, encoding, association and intention.

Visual sensory data is converted into neural impulses which are handled by the central nervous system. This process is unmodifiable by learning. This process is carried on at the lowest level of organization. Before decoding occurs, that is, the arousal of full meaning, there must be discrimination, recoding, and sequencing of

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[16] P. L. Spencer, "The Nature of the Reading Process and Building Balanced Reading Programs," 25th Yearbook, Claremont Reading Conference (1960), p. 5.

[17] Gates, op. cit., p. 17.

[18] A. P. McCreary and A. J. Surkan, "The Human Reading Process and Information Channels of Communication Systems," Journal of Reading, Vol. VIII, No. 6 (1965), 363-372.

data. Recoding is the process of giving a sound equivalent of a visual orthographic pattern, a learned, meaningful process.

The reader discriminates the letters of the orthographic pattern, which in themselves contain no meaning, remembers them in sequence, then recodes them into their oral equivalent. The oral equivalent, which has been given meaning through prior experience, arouses meaning which is then related to the graphic pattern which has been recoded. The graphic pattern has thus been decoded. This is equivalent to word recognition as described earlier.

However, word recognition does not always occur in the sequential pattern suggested in psycholinguistic theory. Children may get their clues to the meaning of the word from the total configuration of the word, and groupings of letters or distinctive features of any one letter located in various positions in the word. In any event, these clues must be synthesized, sequenced and held as a gestalt.

Goodman[19] points out that the complexity of the orthographic pattern which may be recoded and decoded varies with the skill of the reader. The beginning reader may recode individual letters and must therefore remember the sequence of sounds which individually are not meaningful until they form a unit that can be decoded. As skill progresses, the total word or a phrase may be recoded and decoded. Furthermore, as skill develops, recoding as an overt act may not be necessary.

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[19]K. S. Goodman, "The Psycholinguistic Nature of the Reading Process" (paper presented at the Symposium on the Psycholinguistic Nature of the Reading Process, Wayne State University, Detroit, Michigan, May 3-5, 1965, mimeographed).

Goodman[20] also points out that although individual words may have lexical meaning, and can be decoded, it is the flow of language which arouses the meaning intended by the author. Since language contains high frequency function words, such as prepositions, which have meaning in the flow of language, but which have little lexical meaning, it would appear that decoding occurs both at the word level and at levels more complex than the individual word.

Miller[21] suggests that the sentence may be the minimal meaningful unit to consider in decoding language. However, since few sentences have full meaning unless considered in the context of the total message, the total message must also be considered as a unit of decoding. The reader, therefore, must remember a sequence of units which may individually have meaning, but which do not have full meaning unless considered in the context of the whole message. When the sequence is completed, the message may be fully decoded.

As in decoding the individual word, decoding of the total message may or may not require overt recoding. With increasing skill, the process of sequencing becomes more automatic.

Decoding of the complete message is roughly equivalent to the first level of comprehension as described by Gray,[22] that is, the

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[20]K. S. Goodman, "A Psycholinguistic View of Reading Comprehension" (paper presented at the National Reading Conference, Dallas, Texas, December 3, 1965, mimeographed).

[21]G. A. Miller, "The Psycholinguists: On the New Scientists of Language," Encounter, Vol. XXIII, No. 1 (1964), 29-37.

[22]Gray, op. cit., pp. 8-25.

clear grasp of the literal meaning of the message.

While decoding of the message is taking place, ideas aroused by the message will be related to the reader's other past experiences which are relevant to the context of the message. This enables the reader to further interpret the message. This process may be compared to the second and third levels of comprehension as described by Gray[23] or to Gates'[24] concept of comprehension. This is the process previously defined as interpretation.

To complete the communication act, encoding must occur. Encoding is the process whereby the ideas obtained through decoding and interpretation are expressed. This may take the form of speaking, an overt non-verbal motor act, the covert placement of ideas in memory, or any combination of these.

Encoding is approximately equivalent to responding as used by Spencer[25] and Gates.[26] It may occur at any stage in the reading process, that is, during word recognition, phrase, sentence or passage reading.

THE GATES READING TESTS

For purposes of this study the Gates Primary Reading Tests are assumed to reflect the reading process. This battery is made up of

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[23]Gray, op. cit., pp. 8-25.

[24]Gates, op. cit., p. 3.

[25]Spencer, op. cit., p. 5.

[26]Gates, op. cit., p. 3.

three tests: Word Recognition, Sentence Reading, and Paragraph Reading. Gates[27] claims that the battery covers the different aspects of reading, and although word recognition is basic to sentence reading, and sentence reading is basic to paragraph reading, each also measures different phases of reading ability.

Type 1. Word Recognition

This test was designed to sample the ability to read words representative of the primary vocabulary. A picture representing a noun or a verb is presented along with four words, one of which is the orthographic representation of the concept represented by the picture. The reader must encircle the correct word.

The forty-eight exercises have been graded in difficulty by the increased utilization of words that are less frequently used, of sound-symbol relationships further removed from isomorphism, and of words that are similar in general configuration and orthographic detail.

This test measures the ability to decode the individual word. The meaning is aroused by the picture and the reader then chooses the word that arouses the same meaning. Alternative words are similar in configuration and detail, thus requiring the reader to perceive the different elements of each word as well as the general configuration. The elements of the chosen word can then be recoded, remembered in sequence, and then decoded.

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[27] A. I. Gates, Gates Primary Reading Tests: Manual of Directions (New York: Bureau of Publications, Teachers College, Columbia University, 1957).

Type 2. Sentence Reading

This test measures the ability to read sentences of increasing length and complexity. There are forty-five items, each consisting of three sentences marked I, II, III, respectively, and six pictures representing the concepts presented in the sentence. The reader matches each sentence with a picture.

Although decoding of sentences requires decoding of individual words, the emphasis is on decoding a short flow of language. Beyond decoding of individual words, the reader must remember a sequence of words, and use language cues, such as context, sentence patterns, and function words to decode the sentence.

Encoding occurs when the reader marks a picture with the appropriate Roman numeral.

Type 3. Paragraph Reading

This test consists of twenty-six items composed of paragraphs graduated in difficulty and complexity of vocabulary, sentence structure and relationship of sentences. Pictures and instructions are presented along with the paragraph. The reader is required to carry out the instructions: the marking of a selected picture.

This test measures the reader's ability to decode a longer and more complex flow of language than is required in sentence reading. Decoding of only a word, phrase, or one or two sentences is not sufficient to execute the instructions successfully. Thus, to decode the paragraph, the reader is required to decode words and sentences, remember them in sequence, and organize the ideas. The decoded

message is then interpreted, related to the meaning aroused by the picture, and appropriate encoding is carried out.

The tests of this battery resemble a communication act, and require psycholinguistic processes in that the reader is required to organize sensory data, decode it, associate it with other data supplied by pictures and from past experience, determine the correct response and encode it.

The word recognition test requires recoding, sequencing, decoding, interpretation and encoding on the basis of individual lexical items.

Language as a flow of linguistic items is recoded, decoded, interpreted and encoded in the sentence reading test. However, the flow of language is somewhat restricted in this test because only a few basic sentence patterns are presented.

More complex linguistic inter-relationships that require organization of various ideas as the message is being decoded, interpreted and encoded are tested by the paragraph reading test.

Thus, as in the reading process previously described, the test battery requires the same psycholinguistic processes, applied to material of increasing complexity.

THE ILLINOIS TEST OF PSYCHOLINGUISTIC ABILITIES (I.T.P.A.)

The Illinois Test of Psycholinguistic Abilities (I.T.P.A.) is based on a communication model formulated by Osgood[28] and a clinical

[28] Osgood, op. cit., pp. 75-118.

model of linguistic behavior developed by Wepman, Jones, Block and Van Pelt.[29] These models show considerable communality.

Osgood's model consists of two stages and three levels of organization of stimulus and response.

The lowest level of organization, the projection level, is the sensory-motor level where an isomorphic relationship exists between stimulus and response. This level is not modified through learning.

The second level, called integration, organizes and sequences both incoming and outgoing neural events. The high frequency occurrence of a sequence of stimuli or responses becomes organized into an evocative integration. In an evocative integration the occurrence of the first stimulus or response is sufficient condition for the rest of the sequence to occur, and the organism will act on the basis of the first stimulus or response. A visual evocative integration results in closure. The motor equivalent of an evocative integration is illustrated by the opening of a door. Once a person touches the door knob he will grasp and turn it and pull the door open without attending to what he is doing, or without additional cues.

Under conditions of lower frequency of occurrence of a stimulus or response sequence, predictive integrations result in which the occurrence of the first stimulus or response is condition for expecting the next. This differs from the evocative integration

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[29] J. M. Wepman, L. V. Jones, R. O. Block and Doris Van Pelt, "Studies in Aphasia: Background and Theoretical Formulations," Journal of Speech and Hearing Disorders, XXV, 323-332.

in that another cue is required before the next event in the sequence will occur, while the evocative integration does not require this additional cue. A predictive integration is illustrated when someone partially learns a song. They can sing along with someone else, but when required to do so alone, they have difficulty recalling the words.

Osgood explains the functioning of the integration level in language behavior as:

> Generally speaking we find evocative integrations in the smallest skill units of both speaking and listening, and predictive integrations in the grammatical mechanisms that interrelate larger message events.[30]

The integration level organizes input and output but the connection between them is automatic as a result of overlearning.

The third level is named the representative or cognitive level. At this level semantic events are given meaning through a mediating process. At this level the connection between the stimulus and response is voluntary, rather than automatic.

Mediation at the representative level is illustrated when we get the meaning of a word from a dictionary. The meaning of the stimulus word is given in words whose meaning we already know. The mediation occurs when part of the meaning of the familiar word is attached to the stimulus word. This is a voluntary process.

The two stages of this model are decoding and encoding. Decoding is the process by which sensory data are given meaning.

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[30] Osgood, op. cit., p. 81.

Encoding is the process whereby the intentions of the organism are expressed. Mediation, as illustrated above, is the meaning component of decoding and the intention to respond to this meaning. The intention is a component of encoding. Therefore, mediation is the link between, and a part of decoding and encoding.

Figure 1 illustrates a two stage communications model at the representation level. The mediation process is shown to be a part of the decoding and the encoding processes and acts as the link between them.

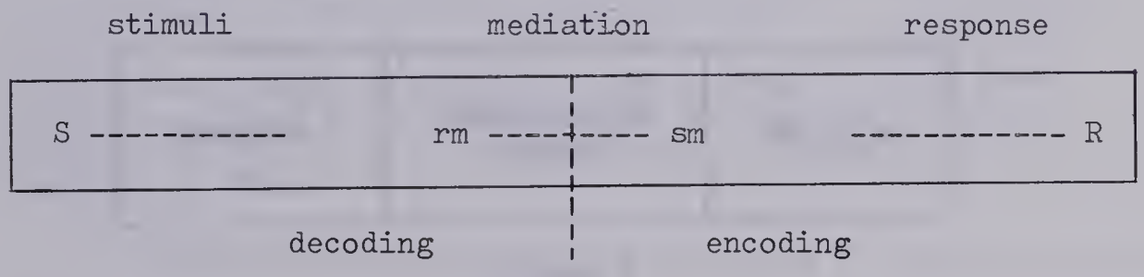

FIGURE 1

A TWO STAGE COMMUNICATIONS MODEL AT THE REPRESENTATIONAL LEVEL

The Wepman et al.[31] model differs from Osgood's model in two ways. The authors represent the second level as non-conceptual. The ability to repeat auditory stimuli, and ability to copy printed stimuli are non-symbolic, while the ability to read aloud and write words presented aurally is in part non-conceptual. These abilities are organized at this level. The grammatical mechanisms organized at the

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[31] Wepman et al., loc. cit.

integration level in Osgood's model are conceptual, even though they are redundant.

The second difference occurs at the representational level. Their model is a three stage model, with decoding and encoding separated by an associative process. This is the stage of comprehension which transcends modality and represents higher level symbolic activity. For purpose of this study, it has previously been defined as interpretation.

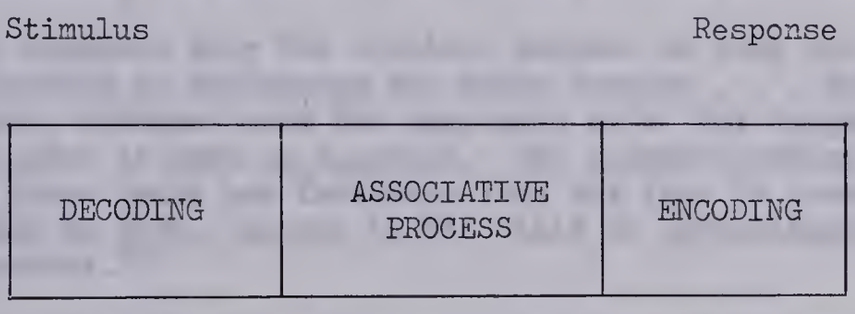

FIGURE 2

A THREE STAGE COMMUNICATION MODEL AT THE REPRESENTATIONAL LEVEL

Kirk and McCarthy utilized both models in developing the Illinois Test of Psycholinguistic Abilities. The representational level has three stages or processes. They define them as follows:

> Decoding refers to those abilities required to obtain meaning from visual and auditory linguistic stimuli, that is, receptive language ability. Association is the ability required to manipulate linguistic symbols internally. It is a central process elicited by decoding and which in turn elicits expressive process. Encoding is the sum of those abilities required to express ideas in words or gestures. All of these processes are interdependent, both in their operation and development.[32]

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[32] S. A. Kirk and J. J. McCarthy, "The Illinois Test of Psycholinguistic Abilities--An Approach to Differential Diagnosis," American Journal of Mental Deficiency, LCVI (1961), 403.

Kirk and McCarthy have therefore utilized Osgood's concept of decoding and encoding but place Wepman et al.'s concept of association as the overlapping factor in place of the mediation process in Osgood's model. The Wepman model is clinical, and is not based on any particular learning theory. Language disturbances, agnosia, aphasia, and apraxia, would tend to support the use of three processes at this level. However, such clear-cut differentiation is not as readily observable in the normal person. McCarthy and Kirk believe they have overcome this interdependence, and made the test items measure only one process by:

> . . . regulate only the critical process in each test while eliminating or minimizing the other process . . . While not perfect, clinical work has convinced us of the diagnostic usefulness of such an approach. Our standardization work with these tests has indicated that the idea is practical and may be widely useful in the field of psycholinguistic assessment.[33]

Although the three processes are assumed to apply to the three levels, the integration level of organization functions automatically, so McCarthy and Kirk were forced to abandon subtests to tap each process at this level, and utilized whole level tests instead.

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[33]J. J. McCarthy and S. A. Kirk, The Construction, Standardization, and Statistical Characteristics of the Illinois Test of Psycholinguistic Abilities (Urbana, Illinois: Institute for Research on Exceptional Children, University of Illinois, 1963), p. 6 (in Test Kit).

> In the interests of assuring clinical usefulness of the test, we have departed somewhat from the theory at the integration level, and in recognition of this we call this level the "automatic-sequential" level (after the actual tests used to implement the level), instead of the "predictive-evocative" level; however, there is good reason to believe this departure is minimal.[34]

Two of the subtests at this level were based on Wepman's model, and one was based on Osgood's model.

Since the projection level is not modified by learning, subtests to investigate this level were not included in the I.T.P.A.

Both Osgood and Wepman speak of sense modalities generally. Kirk and McCarthy[35] believed that visual and auditory input and vocal and other kinds of motor output were most significant to language behavior and therefore utilized only these modalities. Other practical considerations forced them to limit the number of tests to nine.

The model of the I.T.P.A. therefore consists of three processes; decoding, association, and encoding; two levels of organization; representation and automatic-sequential; and two channels (modes) of communication; auditory-vocal and visual-motor.

This test was standardized on children from age two years-six months to nine years and was intended for use with them.

Several subtests have a ceiling level which indicates when the subject has probably reached a maximum. The ceilings were designed to prevent an inflated score due to random guessing.

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[34] McCarthy and Kirk, op. cit., p. 4.

[35] Kirk and McCarthy, op. cit., p. 403.

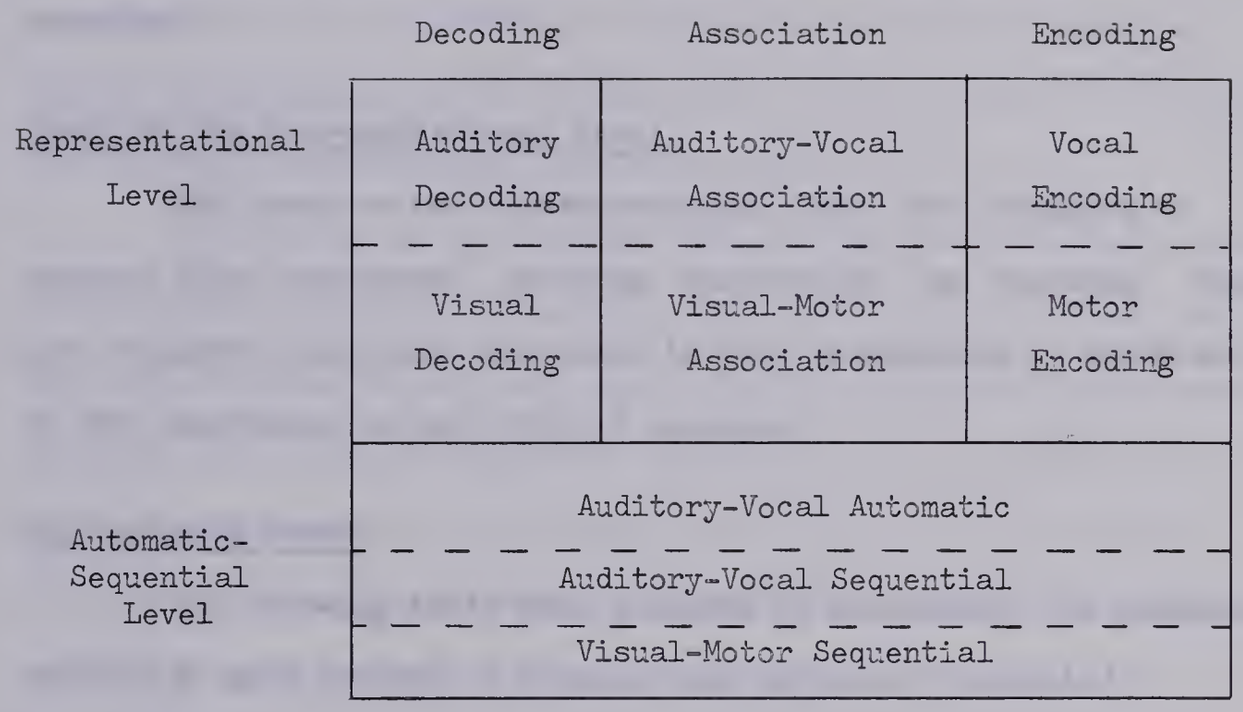

FIGURE 3

A MODEL OF THE ILLINOIS TEST OF PSYCHOLINGUISTIC ABILITIES

Description of Subtests

In the following section, a description of the subtests of the I.T.P.A. is presented. The tests are grouped according to the level of organization and then subdivided according to process being measured.

Tests at the Representational Level

The tests at the representational level were designed to measure three processes: decoding, association, and encoding. These are voluntary conceptual processes in that information is organized by the individual on the basis of concepts.

The Decoding Tests

The decoding tests were designed to investigate the examinee's ability to give meaning to visually and auditorily presented information.

Test 1. Auditory Decoding. Auditory decoding is the ability to give meaning to the spoken word. According to McCarthy and Kirk, "the standard vocabulary test is perhaps the best way to assess this ability . . ."[36] but due to the excessive encoding required, and the inability of young children to define words in a formal manner, a controlled vocabulary test was developed in which the subject is presented with a simple question, the answer to which depends upon his knowledge of the words involved.

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[36]McCarthy and Kirk, op. cit., p. 7.

Questions are of the type "Do airplanes fly?" "Do bicycles drink?" All questions follow this (DO) (NOUN) (VERB) pattern. Encoding is minimized by requiring only a "yes" or "no" answer or a gestural response.

The controlled vocabulary was obtained from the Peabody Picture Vocabulary Test (1959) from which selected items were leveled at half year intervals from age 2-0 through age 9-0.

Examination of this subtest reveals that two individual words must be decoded for success on the item. The child must first decode the noun and then the verb and then determine whether the given verb is within the subset of verbs attributable to the noun. This is basically the process of decoding one particular sentence pattern; therefore, this subtest goes beyond decoding as would be tested by a test where naming single words is required.

Test 2. Visual Decoding. Visual decoding is the ability to give meaning to pictures and written words. Written words could not be used in a test for pre-school children so a picture test was employed. This test was designed to be the visual counterpart of the auditory decoding subtest.

In this test the subject is first presented with a stimulus picture, which is then removed. Four response pictures follow with the subject pointing to the one picture, among the set of four, which represents the same concept as the stimulus picture. The correct picture is conceptually, but not physically identical to the stimulus

picture. Thus a silver knife must be selected as being the same concept as a jack knife.

Item difficulty is increased by using less familiar stimulus pictures, and by making the comparison pictures physically more similar to each other. All pictures are actual photographs to provide maximum cues, and are devoid of any background to prevent excessive distraction.

To minimize encoding, the subject is merely required to point to the correct response picture.

Unlike the decoding of a sentence in the auditory decoding test, this subtest requires decoding of a single stimulus, and in this sense resembles a type of vocabulary test. It also attempts to measure breadth and depth of concepts by using less familiar objects as stimulus pictures, and by making the correct response picture physically less similar to the stimulus object. However, both occur at one time and a low score on this subtest may be due to the lack of breadth or depth in vocabulary and only through careful analysis of errors can it be determined where the difficulty lies.

Association Tests

Association is defined as the ability to relate visual or auditory symbols in a meaningful way. It is assessed by two tests using different channels, the Auditory-Vocal, and the Visual-Motor.

Test 3. Auditory-Vocal Association. This test assesses the ability to relate spoken words in an analogy. Auditory decoding and vocal encoding are controlled by using words familiar to children two

years younger than the age level being tested. Furthermore, a variety of answers are acceptable.

Thus association of ideas through analogies is being tested. This controlled association utilizes a sentence completion technique; for example, "I eat with a spoon; I cut with a _____." (Item 11)

Examination of this subtest reveals that association through analogy is necessary to successfully complete most items because not only is the pattern of sentences requiring completion varied, but analogous relation between nouns, verbs, adjectives and adverbs is required. However, many items require the answer the child might give without the first half of the analogy being presented (e.g., coffee is bitter; sugar is _____). (Item 19)

Although the test does appear to investigate the ability of the subject to make an analogous relation between auditorily presented ideas, this is only one aspect of the types of manipulation a child will do with auditorily presented ideas and cannot, therefore, be considered the measure of the child's ability to cognitively manipulate auditorily presented ideas.

Test 4. Visual-Motor Association. This subtest was designed to investigate the ability of the subject to relate visual symbols in a meaningful way through a picture association test. The subject is presented with a single stimulus picture and a set of four optional pictures, one of which is associated with the stimulus picture. The subject is asked, "Which one of these (pointing to the set of optional pictures) goes with this (pointing to the stimulus picture)?"

The subject is required to choose the one picture from the set of choices which has conceptual communality with the stimulus. For example, the stimulus picture may be a pen. The examinee must choose from among a pencil, nail, needle and a knife the picture which represents the same concept as a pen.

Photographs devoid of background are used to minimize distraction. The correct association in each item was judged to be the one selected by most children, not adults.

Although the basis of conceptual communality is varied throughout the subtest, this is only a minor way of dealing with visual symbols, and like the auditory-vocal association test it can be considered as only a very limited measure of the examinee's ability to relate visual symbols.

Encoding Tests

Encoding is the ability to express ideas in words or gestures. This is assessed by two tests, Vocal Encoding and Motor Encoding.

Test 5. Vocal Encoding. Vocal encoding is the ability to express ideas in spoken words. The child is presented with a familiar object, such as a yellow block of wood, and asked, "Tell me all about this." His score is the number of concepts he enumerates. The objects are of regular shape, solid color and of homogeneous composition, thus minimizing minor details. The test is open ended, but it has a well defined marking system and is not, therefore, unduly influenced by the examiner's interpretation.

An open ended subtest where the subject is required to emit concepts, rather than having them elicited, may be a better measure of the concepts the child can express since more than recognition is required. However, we cannot be certain whether the concepts are lacking or whether the child is unable to express them. The personality of the examinee and the test situation may affect the score on this test. It would appear, therefore, that any meaningful interpretation of the child's ability to express ideas verbally would require analysis beyond the scores.

Test 6. Motor Encoding. This test attempts to measure the subject's ability to express ideas in meaningful gestures. The examinee is shown an object or picture and asked, "Show me what you should do with this." Gestures are encouraged and verbal explanations discouraged by the examiner saying, "No, don't tell me about it. Show me what you would do with it."

Decoding is controlled by using familiar objects or black and white photographs of familiar objects without distracting backgrounds.

This is an open ended test, but the well defined scoring system which is provided is imperative since the gestures are quickly completed.

Kirk[37] states that this ability is related to spatial orientation, and that lack of body image will restrict the examinee's motor encoding abilities. Examination of the test reveals that many

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[37]Kirk, op. cit., p. 60.

musical instruments are employed in this test. Since it is highly unlikely that many children would have had an opportunity to play these instruments, but have probably seen them played, imitative ability seems to be required for success on the subtest. In view of the imitative aspect and the body image factor, it is questionable whether this is a test measuring abilities at the representational level. This subtest may, perhaps, belong at the automatic-sequential level.

Automatic-Sequential Level

Tests at this level deal with the use of symbols, having comparatively little meaning, particularly memory of sequence of linguistic symbols. This is an imitative function. One sub-test also deals with the child's ability to grasp the redundancies in language.

Test 7. Auditory-Vocal Automatic. The ability to predict linguistic events from past experience is assessed by a grammar test. The subject is asked to supply the last word, which requires inflection, to a test statement. For example, "Here is an apple. Here are two _____." (Item 1) The inflections the examinee is required to supply are grammatical redundancies. Difficulty is increased by demanding the insertion of increasingly less familiar inflections.

Although this is an Auditory-Vocal test, pictures are used as support for the auditory statement.

Berko[38] used nonsense words and pictures in a similar test, thus demonstrating that the ability to inflect is located at this automatic-sequential level. In developing the I.T.P.A. nonsense words were abandoned in favor of meaningful words because the majority of children attempt to transform the nonsense words into real words.

Test 8. Auditory-Vocal Sequential. This subtest attempts to measure the immediate recall of an auditorily presented sequence. It resembles the standard digit span test of the WISC and Stanford-Binet, except that the digits are spoken at twice the usual rate, the examiner supplies an additional clue by dropping his voice at the end of the digit sequence, and some sequences repeat a digit. These innovations were introduced to have narrower intervals than do the WISC and Stanford-Binet.

This subtest was designed on the basis of the non-meaningful imitative factor in the Wepman[39] model.

Test 9. Visual-Motor Sequencing. The ability to reproduce a sequence of non-meaningful visual stimuli from memory is tested by having the subject observe the examiner arrange a series of pictures or simple geometric forms and then attempt to reproduce the sequence from memory. The sequence is broken up before the child is asked to

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[38]Jean Berko, "The Child's Learning of English Morphology," Psycholinguistics, S. Saporta, editor (New York: Holt, Rinehart and Winston, 1961), pp. 359-380.

[39]Wepman et al., op. cit., pp. 323-332.

reproduce it.

Increasing difficulty is controlled by introducing more elements into the sequence, using less familiar geometric designs, and using designs that are similar to others, thus requiring greater attention to detail.

It appears that this test measures several factors. Visual discrimination is required to differentiate the geometric designs. Memory for sequence is required and ability to hold this sequence against distraction, as when the sequence is broken up, compound the difficulty of the task.

This subtest was also based on the Wepman et al. model.

EQUIVALENCE AND DIFFERENCES BETWEEN THE ILLINOIS TEST OF PSYCHOLINGUISTIC ABILITIES, THE READING PROCESS, AND THE READING TESTS

The sequential subtests of the I.T.P.A. have an equivalence in the reading process in discrimination of the individual letters, and remembering the sequence of letters to form the whole word. The orthographic patterns are associated with their speech sound equivalents and these are spoken. Decoding has not yet occurred. This process is required in word recognition on the reading test.

However, as has been previously stated, word recognition need not always occur in the sequential manner suggested above. Children may use the configuration of the word, or a cluster of letters, or a single letter, or a combination of these as cues to the meaning of the word.

Equivalence of the sequential subtests of the I.T.P.A. is also found in the sentence reading test, and paragraph reading test in remembering the sequence of words or sentences which have a lexical meaning but require that the whole message be decoded before they have the meaning intended by the author. Again, association of the vocal equivalent of the orthographic pattern, and encoding occur.

With increasing skill in reading, the encoding need not be overt.

The auditory-vocal automatic subtest has equivalence in reading when the reader uses the language redundancies, such as inflections affixed to words, in processing sentences or larger units.

Decoding, association and encoding have equivalence in the reading process and the reading test when the reader must give meaning to the orthographic pattern and the pictures, relate their meanings and carry out the instruction.

The reading tests deal only with the visual-motor channel of communication; however, the auditory-vocal channel is used in learning to read and therefore is significant in reading.

There are several differences between the I.T.P.A. and the Gates Primary Reading Tests, even though it appears that both require the same processes. The processes as measured by the Gates Primary Reading Tests are measured within the context of the reading act, while the processes measured by the I.T.P.A. are measured outside the context of the reading act.

The processes measured by reading tests and by the I.T.P.A. are highly integrated normally. In the I.T.P.A., however, an attempt

has been made to make each process prominent, and therefore isolated, by controlling the stimulus presented or the response required.

As a result of the context and isolation factor, the I.T.P.A. and the Gates Primary Reading Tests may not be measuring the same process to the same extent; therefore, the predictive effectiveness of the I.T.P.A. may be somewhat restricted.

Table I attempts to relate the I.T.P.A. subtests to the reading process, and the Gates Primary Reading Test.

TABLE I

THE RELATIONSHIP OF PSYCHOLINGUISTIC PROCESSES AT EACH LEVEL TO THE GATES READING TESTS

LEVEL OF I.T.P.A.	GATES READING TEST	PSYCHOLINGUISTIC PROCESS IN READING		
		Decoding	Association	Encoding
Automatic-Sequential	Word Recognition	discrimination of letters--memory of sequence of letters--discrimination of sounds--memory of sound sequence	sound-symbol association (associate sound sequence with intuitive knowledge of the phonology of the language)	vocalizing of sounds and of words
	Sentence Reading and Paragraph Reading	memory of sequence of words and sentences	association of sequence of words and intuitive grammar of the language	vocalizing of phrases and sentences
Representational (Subtests 1, 2, 3, 4, 5, 6)	Word Recognition	giving attributed or assigned meaning to word in print or recoded word	association of meaning of word with meaning of picture	circle the correct word
	Sentence Reading	giving meaning to words in terms of the context of the sentence, and thus giving meaning to the sentence	associate meaning of sentence with past experience and the meaning of the picture	mark picture with the appropriate Roman numeral
	Paragraph Reading	giving meaning to words and sentences in the context of the paragraph, thus giving meaning to the paragraph	associate meaning of paragraph with past experience and the meaning of the picture	marking the picture with the appropriate marking as given in the instructions

CHAPTER III

RELATED RESEARCH

STUDIES RELATED TO THE READING PROCESS AND READING ACHIEVEMENT

Many studies have been carried out to examine the various processes involved in reading. The processes can be divided into two broad categories: perceptual and cognitive processes involved in giving literal meaning to the message, and cognitive processes brought to bear on the information after the literal meaning of the message has been obtained. In the following summary each of these broad categories is broken down into sub-categories by the presentation of a series of representational studies.

Vernon[40] has summarized many of the studies which relate visual perception to reading achievement. Among the most significant studies in this area is one carried out by Goins.

Goins[41] related various test results as measures of different aspects of visual perception to reading achievement of children aged five and one half to seven and one half years of age. She found

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[40] M. D. Vernon, Visual Perception and Its Relation to Reading (Newark, Delaware: International Reading Association, 1966).

[41] J. T. Goins, Visual Perceptual Abilities and Early Reading Progress (Supplementary Educational Monographs, No. 87, University of Chicago Press, 1958).

significant correlations for the whole battery of perceptual tests. Several bimodal distributions in the results also suggested two types of perceivers: analyzers, who first perceive the total configuration, then analyze the components of the total configuration; synthesizers, who start with an analysis of the components and then synthesize them into the total configuration.

Deutsch[42] examined the relationship of results on the Wepman Auditory Discrimination Test to verbal and non-verbal intelligence test items and to reading achievement as measured by the Gates Reading Tests. She found that poor readers had greater difficulty in auditory discrimination and in shifting from one modality to another. She postulated a minimum level of auditory discrimination, which if reached no longer influences reading achievement.

Birch and Belmont[43] also found that, in beginners, reading ability is affected by ability to associate auditory and visual patterns.

Kinsbourne and Warrington[44] studied two groups of backward readers aged eight to fourteen, and found that they were characterized

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[42]C. P. Deutsch, "Auditory Discrimination and Learning: Social Factors," Merrill-Palmer Quarterly of Behavior and Development, X (1964), 227-296.

[43]H. G. Birch and Lillian Belmont, "Auditory-Visual Integration in Normal and Retarded Readers," American Journal of Orthopsychiatry, XXXIV (October, 1964), 852-861.

[44]M. Kinsbourne and E. K. Warrington, "Developmental Factors in Reading and Writing Backwardness," British Journal of Psychology, LIV (1963), 145-156.

by either language impairment or deficiency in sequential ordering and inability to recall and manipulate sequences.

Thus, it would appear that several facets of visual and auditory perception, visual-auditory association, cross modality transfer, sequential ordering and language ability are closely related to reading achievement. As will be shown later, these factors have also been found to be good measures of reading readiness, and therefore predictors of reading achievement.

As with the basic perceptual processes many studies have investigated various aspects of higher level cognitive processes involved in reading. Only illustrative studies will be presented.

Davis[45] did a factor analysis of reading test results and found nine factors relevant to reading comprehension. These can be divided into three areas: word knowledge, grasping the literal meaning of the passage read, and higher level comprehension such as suggested by Gates[46] and Gray.[47]

Vernon[48] reviews several studies that indicate language ability in general, and specifically lack of sufficient vocabulary, are correlated with reading disability. It would appear, therefore,

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[45]F. B. Davis, "Fundamental Factors of Comprehension in Reading," Psychometrika, IX (1944), 185-197.

[46]Gates, op. cit., p. 3.

[47]Gray, op. cit., pp. 8-25.

[48]M. D. Vernon, Backwardness in Reading (London, England: Cambridge University Press, 1957), pp. 69-70.

that the level of vocabulary development is positively related to reading achievement.

Piekarz[49] compared good and poor readers, and found that poor readers directed the majority of their attention to the literal or surface meaning of the selection, and gave only passing attention to the implied meanings and to critical evaluation. Good readers were more evenly distributed among the three areas of interpretation. They move freely from the literal surface meaning to the implied meanings and evaluation of the selection.

Compared to those associated with the perceptual aspect of reading, factors related to higher level comprehension in reading are more difficult to isolate. Lenon[50] reports several studies where attempts were made to isolate the factors in reading. Logical analysis reveals several factors, but he suggests that the only factors which may be isolated statistically are word knowledge and reasoning in reading. The other factors may be techniques of reading, or just labels for what are the outcomes of the comprehension process.

ASSESSMENT OF READING ACHIEVEMENT

Most studies utilize standardized reading tests as a measure of reading achievement. These tests have advantages and some serious limitations.

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[49]Josephine A. Piekarz, "Getting Meaning from Reading," Elementary School Journal, LVI (1956), 303-309.

[50]R. T. Lenon, "What Can Be Measured," The Reading Teacher, XV (1962), 326-338.

The construction and scoring of standardized tests makes them inherently objective. However, this objectivity is usually achieved through multiple choice questions. A multiple choice test presents alternative choices to the examinee and merely requires him to recognize the most logical choice. In this way it only tests his ability to recognize, but not his ability to abstract that answer on the basis of his reading and background.

A multiple choice test limits the scope allowed for critical or creative reading. When attempts are made to provide for these factors they provide no opportunity to substantiate a considered choice or support a choice not given. By merely selecting an alternate choice, they do not reveal the depth or subtlety of interpretation, nor do they measure the capacity or ability to interpret to others one's understanding of an abstract concept or idea.

Multiple choice does not always measure what it attempts to measure. Preston[51] reports a study where students were able to recognize the correct answer without reading the passage on which the questions were asked.

Standardized tests are usually statistically valid and reliable for what they purport to measure, but they may not be measuring all the relevant aspects of the reading process, and may not provide opportunity for the known variations likely to influence reading behavior to be included in the test.

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[51] R.C. Preston, "A New Approach to Judging the Validity of Reading Comprehension Tests," Challenge and Experiment in Reading (I.R.A. Conference Proceedings, Vol. VII, 1962), pp. 166-167.

Emons, Urbas, and Dummett[52] report a study where two reading tests which purport to measure reading achievement were used. The results were contradictory when each reading test was considered separately. They point out the need to carefully consider the relationship between the factors being related to reading achievement and what the reading test actually measures.

Barritt[53] likewise points out the need for such considerations in testing reading achievement.

The above criticism of standardized reading achievement tests can also be applied to the Gates Primary Reading Tests used in this study since they are standardized multiple choice tests. However, since they are widely used as a measure of reading achievement, and decisions about the pupils' reading achievement are made on the basis of this battery, the Gates Primary Reading Tests were used as the measure of reading achievement.

PREDICTING READING ACHIEVEMENT

Much of the research relating perception to reading achievement becomes the guide for development of reading readiness tests which attempt to predict reading achievement.

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[52]Robert Emons, Raymond Urbas and Marjorie Dummett, "The Meaning of Reading Tests," Journal of Reading, Vol. IX, No. 6 (1966), 406-410.

[53]T. C. Barritt, "Predicting Reading Achievement Through Reading Tests," Reading and Inquiry (Proceedings of the Annual I.R.A. Convention, Vol. X, 1965), pp. 26-28.

Barritt[54] reviews many studies, as well as his own, of reading readiness. He suggests three factors appear to predict reading achievement. These are: visual discrimination and knowledge of letters, auditory discrimination, and the ability to keep a figure in mind against distraction. He also states that the more closely these tasks resemble the actual reading act the higher will be the relationship between the scores on the readiness test and reading achievement.

Barritt also suggests that other factors such as oral language facility, informational background, story sense, interest in reading, and attitude toward reading are also important readiness factors.

deHirsch, Jansky and Langford[55] studied the predictive efficiency of thirty-seven tests which previous research showed to test factors related to reading achievement. The Gates Advanced Primary Reading Test and the Gray Oral Reading Test were their reading achievement criteria. They found both verbal and non-verbal tests to be significant predictors of reading achievement.

The verbal tests which were significant predictors were auditory discrimination tests, Peabody Picture Vocabulary Test, expressive and receptive oral language tests, and visual perception tests which require the child to respond to abstract form (letters and words). These tests include factors which Barritt suggested will be predictive

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[54] T. C. Barritt, "The Relationship Between Measures of Pre-Reading Visual Discrimination and First Grade Reading Achievement: A Review of the Literature," Reading Research Quarterly, I (1965), pp. 51-77.

[55] Katrina deHirsch, J. J. Jansky and W. S. Langford, Predicting Reading Failure (New York: Harper and Row, 1966).

of reading achievement because they closely resemble the actual reading act.

Grapho-motor, visual-motor, and auditory-motor tests were good predictors since they represent the child's awareness of his own body schema which enters into reading, and require integration of sense and motor modalities. Although these tests do not resemble the reading act, they are predictive because:

> In our opinion the predictive efficacy of the tests depends not on the specific skills involved, but on the degree to which they measured integrative ability. . . . [the child] must be able to use information gained from both auditory and visual clues--in other words, he must be able to integrate intersensory information, a very demanding task.[56]

RELATIONSHIP OF RESEARCH IN READING AND READING READINESS, TO THE ILLINOIS TEST OF PSYCHOLINGUISTIC ABILITIES

Studies have indicated that there are two broad classifications of factors related to reading achievement; basic perceptual processes, and more specific higher level cognitive processes. The perceptual processes can be further broken down into verbal and non-verbal categories, both significant in predicting reading achievement. The I.T.P.A. likewise measures these basic perceptual processes and their intermodality integration. Tests at the automatic sequential level require reception, discrimination, association, and integration of sensory data, and response to this data. These tests are

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[56] Ibid., p. 38.

essentially non-verbal. The decoding and encoding tests at the representational level require the same processes, but are verbal as well as non-verbal.

Research indicates that specific higher level cognitive processes are required in reading. As has been shown, these are difficult to isolate and therefore it is not surprising that few attempts have been made to directly measure these processes in readiness tests. However, these processes may be required to successfully carry out the tasks in the readiness tests.

The I.T.P.A. attempts to measure specifically these processes with the associative tests at the representational level.

RESEARCH RELATED TO THE ILLINOIS TEST OF PSYCHOLINGUISTIC ABILITIES

A considerable number of studies have been carried out to determine the patterns of psycholinguistic abilities and disabilities of exceptional children. Only a very limited number of studies have attempted to relate psycholinguistic abilities to reading achievement.

Bateman used the Illinois Test of Psycholinguistic Abilities to determine the relationship of psycholinguistic abilities to reading achievement in partially seeing children. The subjects were children in grades one to four in special classes for the partially sighted.

She found that:

> Reading achievement as measured by deviation of reading grade placement was significantly correlated with the Auditory-Vocal Sequential (r equals .44), Visual-Motor Sequential (r equals .35), and Auditory-Vocal Automatic (r equals .43) subtests which constitute the automatic-sequential level of language usage.[57]

In this study, Bateman did not use a control group. For the reading test, 1932 norms were used. The use of norms this old is questionable. Furthermore, many of the children involved in this study were at the upper end of the norms for the I.T.P.A. Kirk[58] warns that norms for this age level may not be accurate.

Sutton[59] used the Visual-Motor Sequencing subtest of the I.T.P.A. along with other tests believed to tap this level of organization. Her subjects were two groups of educable mentally retarded children with chronological age range from eight years, ten months, to eleven years, two months.

The results indicate that high reading achievers scored higher, but not significantly so, on the tests which involve sequencing. Differences were significant on tests of letter recognition and writing of letters on consonant groups.

These results are somewhat at variance with Bateman's results, but since the groups differ, and neither study used a control group, comparison of results is not very meaningful.

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[57]B. D. Bateman, "Reading and Psycholinguistic Processes of Partially Seeing Children," Selected Studies on the Illinois Test of Psycholinguistic Abilities (Urbana, Illinois: Institute for Research on Exceptional Children, University of Illinois, 1966), pp. 70-87 (in Test Kit).

[58]Kirk, op. cit., p. 41.

[59]Peggy Sutton, "The Relationship of Visualizing Abilities to Reading," The Illinois Test of Psycholinguistic Abilities in Current Research, B. D. Bateman, editor (Urbana, Illinois: Institute for Research on Exceptional Children, University of Illinois, 1965), p. 24.

Ragland[60] used two groups of educable mentally retarded children in her study. They ranged in chronological age from twelve to sixteen years. One group of fifteen children were retarded at least one year in reading achievement, while the fifteen non-retarded readers were within six months of reading potential as computed on the basis of mental age.

The results show that retarded readers were significantly inferior to non-retarded readers on subtests at the automatic-sequential level and on the total test score.

Ragland's study also indicated that function at the automatic-sequential level is related to reading achievement, but as in previous studies cited, the results were obtained with exceptional children and may not be applicable to normal children.

Kass[61] supplemented the automatic-sequential level with five other tests believed to tap this level of organization. Her sample consisted of twenty-one normal children, chronological ages ranging from seven years to nine years, eleven months, but retarded in reading.

The subjects were deficient in five out of the eight tests at the automatic-sequential level and in one out of six at the representational level.

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[60] G. G. Ragland, "The Performance of Educable Mentally Handicapped Students of Different Reading Ability on the I.T.P.A.," The Illinois Test of Psycholinguistic Abilities in Current Research, B. D. Bateman, editor (Urbana, Illinois: Institute for Research on Exceptional Children, University of Illinois, 1965), p. 25.

[61] C. E. Kass, "Psycholinguistic Disabilities of Children with Reading Problems," Exceptional Children, XXXII (1966), 533-539.

This study tends to support other studies indicating that reading retardation is related to the ability to function at the automatic-sequential level. However, like the other studies, this one did not use a control group, so the generalization may be inaccurate since it is entirely possible that non-retarded readers will likewise be found to be deficient in the automatic-sequential level tests. Furthermore, the subjects in the Kass study were at the upper end of the age range of the I.T.P.A. where norms tend to be inaccurate.

SUMMARY AND COMMENT ON THE ILLINOIS TEST OF PSYCHOLINGUISTIC ABILITIES

The studies which related psycholinguistic abilities, as measured by the I.T.P.A., to reading achievement tend to indicate that reading retardation is related to the ability to handle material at a non-meaningful level. However, since neither of the studies used normal children who were not retarded in reading as a control group, the generalization may be inaccurate. The subtests at the automatic-sequential level may be measuring a factor not related to reading. This would be substantiated if no significant differences on the automatic-sequential subtests were found between retarded and non-retarded readers who are normal children.

Furthermore, Bateman has stated,

> The evidence is mounting that we need to critically re-evaluate the emphasis on reading as a meaningful process of comprehension and refocus on the arbitrary, mechanical, non-meaningful aspects of word recognition.[62]

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[62] Bateman, op. cit., p. 27.

This conclusion is drawn on the basis of studies conducted with the I.T.P.A. after reading retardation was known. More emphasis on the "arbitrary, mechanical, non-meaningful aspects of word recognition" may be necessary for some children, but may impede reading development for the larger proportion of children who do not require such emphasis.

Psycholinguistic abilities develop repidly in children during their first year of school attendance even though there is "emphasis on reading as a meaningful process of comprehension." Therefore, it is necessary to determine whether performance on the I.T.P.A. before there is any formal teaching of reading will predict reading achievement at the end of the first grade.

CHAPTER IV

THE EXPERIMENTAL DESIGN

POPULATION AND SAMPLE

The population of this study consisted of the pupils in six elementary schools in the Edmonton Public School System selected by the Director of Primary Education, Edmonton Public School Board. With the aid of random numbers,[63] thirty beginning students were selected from the six schools. Such a small sample was dictated by the length of the teaching procedures. This sample consisted of seventeen boys and thirteen girls. Chronological age, Detroit Beginning First Grade Intelligence Test: Revised, Form A[64] scores and father's occupation were obtained from the cumulative records. An occupation class scale[65] was used to determine the socio-economic status of each student.

TESTING INSTRUMENTS

Validity of the Gates Primary Reading Tests

The Gates Primary Reading Tests have been designed to measure three aspects of the reading process: word recognition, sentence reading, and paragraph reading.

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[63] J.F. Kenney and E.S. Keeping, Mathematics of Statistics, Part One (Princeton, New Jersey: D. Van Nostrand Co., 1956), pp. 330-333.

[64] Detroit Beginning First-Grade Intelligence Test: Revised, Form A (New York: Harcourt, Brace and World, Inc.,).

[65] B.R. Blishen, "The Construction and Use of an Occupational Class Scale," Canadian Journal of Economics and Political Science, XXIV (1958), 519-530.

Eller[66] states that the tests are regarded favorably by teachers and administrators because they can be administered in fifty minutes, the items require activities teachers consider to be valid measures of primary reading, norms are easy to interpret, and the manual provides many pedagogical suggestions. These tests, therefore, are used extensively.

According to Burros[67] the reliability is excellent and the items appear to possess face validity.

Eller,[68] on the basis of test intercorrelations, questions whether the three tests measure three relatively different abilities, and therefore suggests that they should be considered as three parts of a single test.

Eller also states that the tests correlate well with other measures of reading ability, including overall appraisal by classroom teachers.

Morrison[69] claims that some of the Sentence Reading items can be answered by identifying only one word, and many of the Paragraph Reading items can be answered by reading only one sentence.

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[66]William Eller, "Gates Primary Reading Tests," The Sixth Mental Measurement Yearbook, O. K. Buros, editor (Highland Park, New Jersey: The Gryphon Press, 1965), p. 1063.

[67]O. K. Buros (ed.), The Sixth Mental Measurement Yearbook (Highland Park, New Jersey: The Gryphon Press, 1965), pp. 1058-1059.

[68]Eller, op. cit., p. 1063.

[69]Coleman Morrison, "Gates Primary Reading Tests," The Sixth Mental Measurement Yearbook, O. K. Buros, editor (Highland Park, New Jersey: The Gryphon Press, 1965), p. 1064.

The criticism of the Sentence Reading tests is based on one sentence pattern, "This is a _____," being used several times. Even though the pattern is repeated, it must be perceived and recognized before the examinee can respond to it.

Although some of the Paragraph Reading items can be answered on the basis of reading only one sentence, the whole paragraph must be read to select the vital sentence. Selection of relevant information is an important aspect of reading and reflects the reader's skill in reading.

Questions were raised about the method of providing norms, but this is not vital to this study because raw scores will be used in the analysis. Furthermore, the statistical analysis may indicate whether the three tests are measuring relatively different abilities.

Standardization and Validity of the Illinois Test of Psycholinguistic Abilities

McCarthy and Kirk[70] carried out standardization and validity studies of the I.T.P.A. in Decatur, Illinois which is reported to approximate the United States on the basis of the father's occupation.

The sample of seven hundred was selected out of a population of 1,100. Excluded from the sample were: children with Stanford Binet I.Q. below 80, and above 120; children with serious sensory or physical handicap; Negroid children; parochial school children; and children who

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[70]J.J. McCarthy and S.A. Kirk, The Construction, Standardization and Statistical Characteristics of the Illinois Test of Psycholinguistic Abilities (Urbana, Illinois: Institute for Research on Exceptional Children, University of Illinois, 1963) (in Test Kit).

spoke a language other than English at home. Preschool subjects were primarily younger siblings of children in the sample or the first or only child of families living in the same neighborhood as the sample children.

McCarthy and Olsen[71] carried out further validity studies on the I.T.P.A.

The concurrent validity coefficients for the nine subtests ranged from .03 to .65 with a median of .15. Measures of predictive validity ranged from .19 to .53 with a median of .23. Content validity is partially demonstrated by tests of internal consistency whose coefficients indicate to what extent test items within a subscale are measuring the same ability. Range of coefficients was .69 to .84 with a median of .75.

The test appears to have no marked sex bias, or favor girls only slightly. Age differences were found at one-half year intervals except between 7.5 and 8.0 years, and 8.5 and 9.0 years. These were therefore combined with the next higher level. Age differentiation of the test was more effective up to age seven years than after this age. The test also appears to have the best consistency in the middle of the age range, at six years of age.

McCarthy[72] provides the following summary of validity characteristics of the I.T.P.A. (cf. Table II).

Two of the I.T.P.A. subtests were judged to have doubtful validity, three excellent validity and four intermediate concurrent and predictive validity.

To determine the factors that affect the I.T.P.A., construct validity was tested. It was found that the total battery and individual subtests appear to be inversely related to social class, number of

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[71]J.J. McCarthy and J.L. Olsen, Validity Studies on the Illinois Test of Psycholinguistic Abilities (Urbana, Illinois: Institute for Research on Exceptional Children, University of Illinois, 1964),(in Test Kit).

[72]J.J. McCarthy, "Notes on the Validity of the I.T.P.A.," Mental Retardation (April, 1965), pp. 25-26.

TABLE II

SUMMARY OF THE VALIDITY CHARACTERISTICS OF THE I.T.P.A. AND ITS INDIVIDUAL SUBTESTS[73]

I.T.P.A.	Types of Validity			
	Concurrent & Predictive	Content	Construct	Diagnostic
Whole test	Yes [a]	Omissions Noted	e, f	Moderate to Significant
Visual Decoding	Yes	c, d	Yes	g
Auditory Decoding	Qualified [b]	c, d	Yes	g
Visual-Motor Association	Yes	c, d	Yes	g
Auditory-Vocal Assoc.	Qualified [b]	c, d	Yes	g
Motor Encoding	Doubtful	c, d	Yes	g
Vocal Encoding	Questionable	c, d	Yes	g
Visual-Motor Sequence	Qualified [b]	c	Qual. [b]	g
Auditory-Vocal Sequence	Yes	c	Yes	g
Auditory-Vocal Automatic	Doubtful	c	No	g

[a] Criterion tests and retests included the reading and spelling section of the Stanford Achievement Battery, the reading section of the Burrell-Sullivan Capacity Test, the Raven's Progressive Matrices, the Goodenough Draw-a-Man Test, the Peabody Picture Vocabulary Test, and the mean length of response and sentence complexity.

[b] A qualified 'yes.'

[c] Standard error ranges recommended. Subtests internally consistent and fairly heterogeneous with respect to one another.

[d] Basically "single ability" in character.

[e] Inversely related to social class, number of sibs, and position among sibs; positively related to mental age; zero relation to sex of subject.

[f] Stability coefficients vary from .70 to .95.

[g] Classification, by type of child, can be made reasonably well by "experts" on linguistically handicapped children; the test is not sufficiently sensitive to confirm teachers' ranking of I.T.P.A. subtests for linguistically "normal" children.

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[73] Ibid.

siblings and position in sibling order. Sex had little effect on scores. The test also appears to have test-retest stability.

McCarthy[74] suggests that the Encoding subtests, and especially the Auditory-Vocal Automatic subtest may deviate from the definition in the manual, and therefore other tests and clinical observations should be used to confirm performance on them.

Weener, Barritt and Semmel[75] claim that reliability and validity are not yet adequately established. They also criticize the small restricted sample used by McCarthy and Olsen in their validity studies. They do, however, state that the available information does indicate that a range of abilities is assessed by the I.T.P.A.

Barritt, Semmel and Weener[76] compared I.T.P.A. profiles of socio-economic "advantaged" and disadvantaged" kindergarten and first grade children. They found the greatest concordance between groups on subtests requiring sequential habits (subtests 8 and 9) and the largest discrepancies on Auditory-Vocal Automatic, Auditory Decoding and Auditory-Vocal Association.

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[74] Ibid.

[75] P.D. Weener, L.S. Barritt, and M.I. Semmel, "A Critical Evaluation of the Illinois Test of Psycholinguistic Abilities" (Centre for Research on Language and Language Behavior, University of Michigan). (Mimeographed.)

[76] L.S. Barritt, M.I. Semmel, and P. Weener, "A Comparison of the Psycholinguistic Functioning of 'Educationally-Deprived' and 'Educationally-Advantaged' Children (Centre for Research on Language and Language Behavior, University of Michigan). (Mimeographed.)

Their previous criticism of the restricted sample is therefore justified.

Other validity studies were carried out with the I.T.P.A., but since they dealt with exceptional children, they are not relevant to this study.

DATA COLLECTION

The I.T.P.A. was administered to the subjects in the sample by the investigator and an assistant trained in administering individual tests, during the latter part of September, 1966. The Gates Primary Reading Tests were administered by the investigator during the month of May, 1967.

DATA ANALYSIS

The test results were punched on I.B.M. cards and were processed by an I.B.M. computer. A step wise multiple linear regression analysis determined the rank order of the I.T.P.A. total score, subtest scores and groupings of subtest scores, in the context of the other subtest scores, in their contribution to the prediction of reading achievement as measured by the Gates Primary Reading Tests.

CHAPTER V

ANALYSIS AND INTERPRETATION OF DATA

In this chapter the data gathered in order to test the experimental hypotheses are analyzed and interpreted. The data are presented in the following order: first, a statistical description of the sample used in the study, and the achievement of these subjects on the Illinois Test of Psycholinguistic Abilities and on the Gates Primary Reading Tests; next, an analysis of the I.T.P.A. in relation to sex, I.Q., mental age, and socio-economic status; third, an analysis of reading achievement in relation to the I.T.P.A., I.Q., mental age, and socio-economic status; and fourth, a summary of the findings.

STATISTICAL DESCRIPTION OF THE SAMPLE AND THEIR ACHIEVEMENT

Six schools out of the total number of schools in the Edmonton Public School District were selected by the Director of Primary Education, Edmonton Public School District, as being representative of the district. Out of the population of pupils in the six schools, thirty school beginning pupils were randomly selected to constitute the sample of this study.

The Illinois Test of Psycholinguistic Abilities was administered to the pupils in the sample during the latter part of September, 1966. This testing was carried out by the researcher, and an assistant trained in the administration of this test.

During the earlier part of May, 1967, the Gates Primary Reading Test was administered to the twenty seven pupils out of the original sample of thirty who still remained in the school system. Three pupils out of the original sample of thirty had moved to other parts of the province and were not available for testing with the criterion test.

Table III identifies the pupils and gives their sex, I.Q., mental age, and socio-economic status, and their achievement on the I.T.P.A. and Gates Primary Reading Test.

THE RELATIONSHIP OF SEX, I.Q., MENTAL AGE AND SOCIO-ECONOMIC STATUS TO ACHIEVEMENT ON THE ILLINOIS TEST OF PSYCHOLINGUISTIC ABILITIES

The validity of the Illinois Test of Psycholinguistic Abilities was questioned by Weener, Barritt and Semmel.[77] Partly in attempt to explore the influences on achievement as measured by the I.T.P.A., a stepwise multiple linear regression analysis of the I.T.P.A. scores was carried out to determine the relationship of achievement on the I.T.P.A. to sex, I.Q., mental age, and socio-economic status.

The latter three variables correlated significantly with reading achievement and if significantly related to achievement on the

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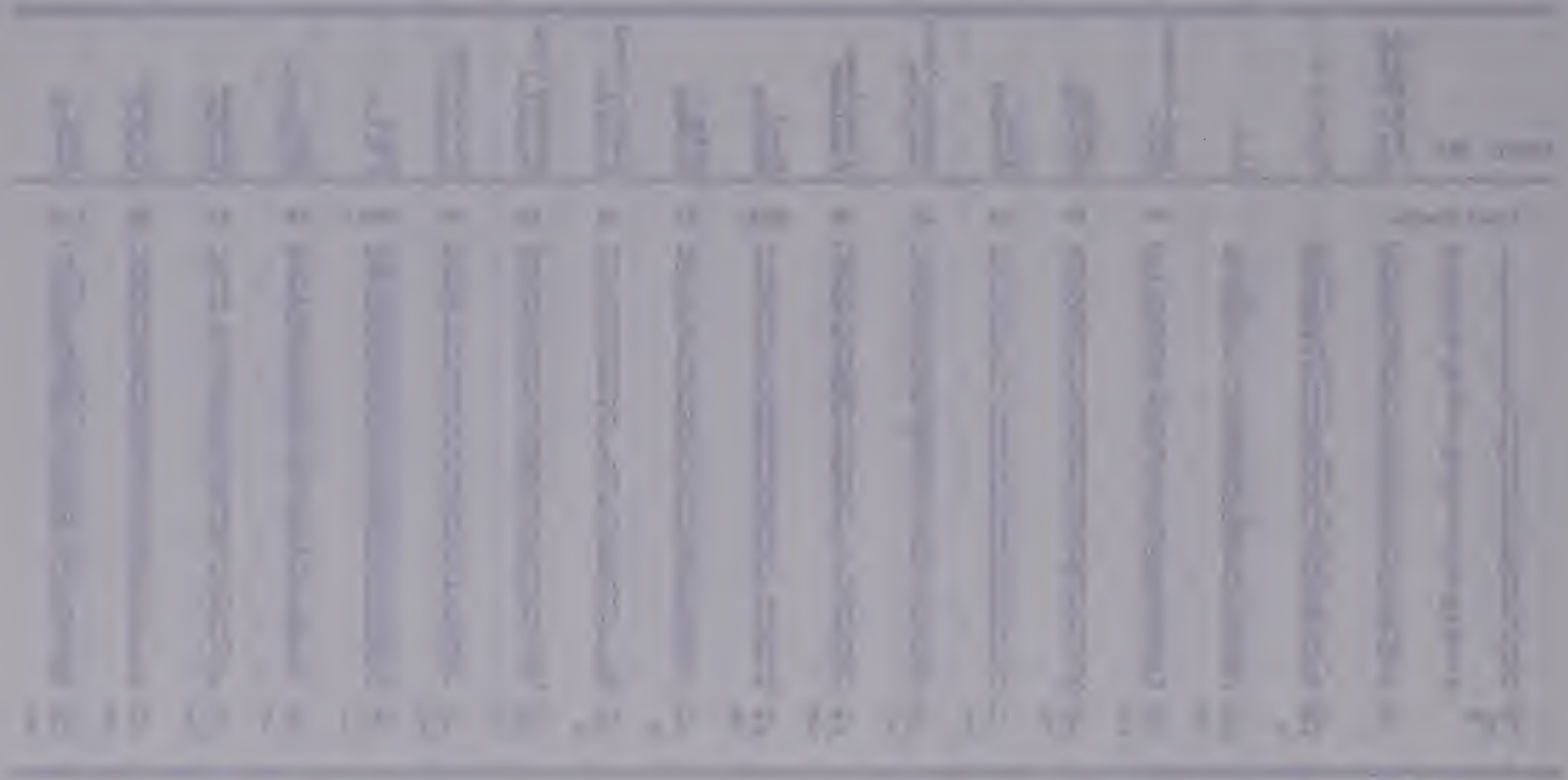
[77] P.D. Weener, L.S. Barritt, and M.I. Semmel, "A Critical Evaluation of the Illinois Test of Psycholinguistic Abilities" (Centre for Research on Language and Language Behavior, University of Michigan). (Mimeographed.)

TABLE III

STATISTICAL DESCRIPTION OF THE PUPILS IN THE SAMPLE AND THEIR ACHIEVEMENTS ON THE ILLINOIS TEST OF PSYCHOLINGUISTIC ABILITIES[1] AND GATES PRIMARY READING TESTS[1]

PUPIL	SEX	Chronological Age in Months	Detroit I.Q.	M.A.	Socio-Economic Status	Auditory Decoding	Visual Decoding	Auditory-Vocal Association	Visual-Motor Association	Vocal Encoding	Motor Encoding	Auditory Vocal Automatic	Auditory Vocal Sequential	Visual-Motor Sequential	Total I.T.P.A.	Word Recognition	Sentence Reading	Paragraph Reading	Total Reading
Total Possible					**	36	24	26	28	NUL*	27	22	40	30	NUL*	48	45	26	119
1	M	78	95	74	75	26	14	23	17	16	14	16	24	13	163	39	19	13	71
2	M	72	135	97	75	24	18	20	20	15	20	14	19	16	166	36	27	18	81
3	M	74	133	98	72	29	17	24	16	17	19	14	26	15	177	48	41	26	115
4	M	76	136	103	60	30	15	23	10	29	16	14	21	16	174	48	44	25	117
5	M	73	104	76	58	25	14	15	8	11	8	12	25	2	120	20	7	11	38
6	M	81	94	76	58	20	12	19	19	14	21	16	36	12	169	44	24	22	90
7	F	83	89	74	45	25	9	16	11	10	8	14	20	15	128	39	27	18	84
8	M	71	108	77	64	15	12	17	12	6	13	10	29	13	126	39	37	25	101
9	F	74	111	81	75	18	17	21	20	12	15	14	18	15	150	47	33	23	103
10	F	75	119	90	64	26	7	19	24	22	13	16	23	17	167	40	36	23	100
11	F	75	114	85	58	24	15	21	17	16	16	14	27	14	164	48	39	25	112
12	F	71	95	67	47	18	17	20	13	14	12	6	22	12	134	35	29	20	84
13	M	70	88	62	47	29	14	21	18	11	16	9	18	12	148	21	17	17	55
14	F	74	117	86	54	21	15	16	13	13	15	12	20	14	139	39	29	21	89
15	M	76	112	85	64	16	14	20	16	16	18	11	24	15	150	47	40	25	112
16	F	75	93	70	51	19	13	21	18	12	13	9	17	16	138	31	24	15	70
17	F	74	114	100	50	27	13	19	12	20	15	12	26	12	156	40	41	22	103
18	F	74	93	69	47	26	13	18	9	15	15	12	18	13	139	36	23	16	75
19	M	74	100	74	40	31	16	22	17	19	18	16	30	15	185	43	37	21	101
20	M	76	84	64	38	20	15	17	9	15	12	13	19	6	126	19	14	10	43
21	F	70	103	72	38	24	13	19	13	7	12	14	16	14	132	30	31	15	76
22	M	76	95	72	48	12	18	20	21	11	19	12	26	6	145	9	16	7	32
23	M	78	108	84	49	23	12	19	12	17	19	11	18	13	144	33	30	19	82
24	M	73	94	68	50	15	13	17	13	10	16	9	31	10	134	28	15	8	51
25	F	80	84	67	41	17	6	12	13	12	15	5	16	12	108	8	14	5	27
26	F	74	119	88	62	27	16	21	20	17	16	13	26	16	172	32	30	18	80
27	M	78	97	76	43	24	12	18	11	19	12	10	21	7	134	7	9	8	24
Mean		75	105	78.5	54.5	22.6	13.7	19.1	14.8	14.6	15	12	22.8	12.6	147.7	33.5	27.1	17.6	78.3
S.D.		3.1	14.9	10.7	11.4	5.1	2.9	2.6	4.2	4.7	3.2	2.8	5.1	3.6	19.5	12.3	10.5	6.2	27.8

[1]Reported scores are raw scores
*No upper limit established
**Range of scale is 32-90



I.T.P.A., they may limit the effectiveness of the I.T.P.A. in predicting reading achievements. Table IV gives the rank order of predictors, significant at the 0.1 level of confidence, and the per cent of variance accounted for by each.

Mental age was found to significantly predict achievement on five of the nine subtests and acted as suppression variable on one more. It predicted achievement on the I.T.P.A. most consistently and contributed from 13.6% to 35.65% of the variance of prediction.

I.Q. was judged to be the second most significant predictor since it ranked first on prediction of two subtests. Since I.Q. is also included in mental age, and correlates at .96191 with mental age, its relevance to achievement on the I.T.P.A. may be inferred from the significance of mental age to achievement on the I.T.P.A.

Socio-economic status which correlates at .64767 with I.Q. ranked first on one subtest and second on another.

Although sex significantly predicted achievement on four of the nine subtests, it always ranked last in the order of predictors.

It would appear that achievement on the I.T.P.A. is related to mental age, I.Q., socio-economic status and sex in that order. However, since intercorrelations between mental age, I.Q., and socio-economic status are relatively high, and the children with the highest I.Q. were boys who also rated high on socio-economic status, it is suggested that I.Q. may be the most important factor.

TABLE IV

RELATIONSHIP OF SEX, I.Q., MENTAL AGE, AND SOCIO-ECONOMIC STATUS TO ACHIEVEMENT ON THE ILLINOIS TEST OF PSYCHOLINGUISTIC ABILITIES

Criterion	Predictor	% of Variance	Cumulative Variance	t(.01)
Visual Decoding	I.Q.	12.41		
	Mental Age	14.78	27.17	4.86
	Sex	7.58	34.76	2.67
Auditory-Vocal Association	I.Q.	20.23	20.23	2.49
Visual-Motor Association	Socio-economic Status	21.10	21.10	2.52
Vocal Decoding	Mental Age	35.65		
	Socio-economic Status	7.75	43.41	3.29
Motor Encoding	Mental Age	13.60		
	Sex	11.39	25.00	3.65
Auditory-Vocal Automatic	Mental Age	20.96	20.96	2.51
Auditory-Vocal Sequential	Mental Age	13.60		
	Sex	11.39	25.00	3.65
Visual-Motor Sequential	Mental Age	23.13		
	Sex	17.27	40.40	6.69

ANALYSIS OF READING ACHIEVEMENT

The purpose of this study was to determine the effectiveness of the I.T.P.A. in predicting reading achievement. However, significant correlations at the .01 level of confidence were noted between I.Q., mental age and socio-economic status, and reading achievement. Table V present these correlations.

TABLE V

CORRELATION* OF READING ACHIEVEMENT AND I.Q., MENTAL AGE AND SOCIO-ECONOMIC STATUS

	I.Q.	M.A.	Socio-Economic Status
Word Recognition	.56616	.57393	.55108
Sentence Reading	.67387	.65669	
Paragraph Reading	.64220	.62281	.49253
Total Reading Score	.64990	.64250	.48965
I.Q.		.96191	.64767

*All scores printed are significant at the .01 level of confidence.

As was previously shown, mental age, I.Q., socio-economic status and sex are related to achievement on the I.T.P.A. Table V shows that three of the four variables are also significantly related to reading achievement. It was therefore postulated that if these three variables are included in the context of the I.T.P.A. as predictors of reading

achievement, they will alter the effectiveness of the I.T.P.A. in predicting reading achievement.

To test the hypotheses stated in Chapter I of this study, and also to test the postulate previously stated, a step wise multiple linear regression analysis of the data was carried out. To test the hypotheses, only the I.T.P.A. scores were analyzed. To test the postulate, I.Q., mental age, and socio-economic status were included in the context of the I.T.P.A. as predictors of reading achievement.

The data are presented in the following order:

Scores of individual subtests of the I.T.P.A. as predictors of reading achievement

Individual subtests scores, plus total I.T.P.A. score as predictors of reading achievement

Individual subtest scores, plus total I.T.P.A. score, plus score of groupings of subtests of the I.T.P.A. as predictors of reading achievement

Summary of findings of predicting reading achievement with achievement on the I.T.P.A.

Scores of individual subtests of the I.T.P.A., plus I.Q., plus mental age, plus socio-economic status as predictors of reading achievement

Summary

Scores of Individual Subtests of the Illinois Test of Psycholinguistic Abilities as Predictors of Reading Achievement

Table VI presents the rank order of effectiveness of the scores of the individual subtests of the I.T.P.A. in predicting reading achievement.

TABLE VI

INDIVIDUAL ILLINOIS TEST OF PSYCHOLINGUISTIC ABILITIES
SUBTEST SCORES AS PREDICTORS OF READING ACHIEVEMENT

Criterion	Ranked Predictors	% of Variance	Cumulative Variance	t(.01)
Word Recognition	(9) V-m Sequential	48.77		
	(8) A-V Sequential	14.16	62.93	9.17
	(7) A-V Automatic	6.09	69.02	4.52
	*(4) V-m Association	7.82	76.84	7.43
	(2) Visual Decoding	4.22	81.06	4.68
Sentence Reading	(9) V-m Sequential	55.09		
	(8) A-V Sequential	6.39	61.48	3.98
	*(4) V-m Association	4.20	65.68	2.84
	(2) Visual Decoding	4.51	70.19	3.33
Paragraph Reading	(9) V-m Sequential	43.57		
	(8) A-V Sequential	10.17	53.74	5.28
Total Reading Score	(9) V-m Sequential	54.51		
	(8) A-V Sequential	11.16	65.67	7.80
	*(4) V-m Association	4.81	70.48	3.75
	(2) Visual Decoding	5.66	76.14	5.22
	(7) A-V Automatic	2.98	79.12	2.99

*Subtest 4, Visual-Motor Association, has a negative weight.

In predicting success on the word recognition test, within the context of all the subtests, the score of subtest nine (visual-motor sequential) was the best predictor and accounts for 48.77% of the predictive variance.

Of the remaining eight subtests, auditory-vocal sequential (subtest 8), when combined with subtest nine, accounts for 62.93% of the variance. Subtest eight, within the context of subtest eight plus subtest nine accounts for 14.16% of the prediction.

Auditory-vocal automatic (subtest 7), which in the context of subtest eight and nine contributes 6.09% of the variance, raised the total variance for the group of three subtests to 69.02%.

The above three subtests compose the automatic-sequential level of the I.T.P.A., which correlates at .73190 with the word recognition scores.

Out of the remaining six subtests, visual-motor association (subtest 4), when combined with the previous three subtests, raises the per cent of variance to 76.84%. It contributes 7.82% of the variance of prediction.

Subtest four did not correlate significantly with reading achievement, and has a negative weight in the prediction equation. It therefore functions as a suppression variable.

Guilford[78] states that a variable which does not correlate significantly with the criterion may still contribute to the prediction

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[78]J. P. Guilford, Fundamental Statistics in Psychology and Education, Fourth Edition (New York: McGraw-Hill Book Company, 1965), p. 406.

of the criterion by suppressing in the other independent variables that part of the variance that is not represented in the criterion, but that still correlates significantly with the criterion.

An illustration of the function of a suppression variable is the prediction of pilot skill with a reading test and a vocabulary test that has a negative weight in the prediction equation. The vocabulary test in effect will cancel out the verbal aspect of the reading test. This then leaves what can be called the reasoning aspect of the reading test to make the prediction. It is reasoning ability rather than reading ability and size of vocabulary that predicts skill as a pilot.

When the extraneous factors in the first three subtests are suppressed by including subtest four, the variance accounted for rises, as does the degree of confidence with which we can use these subtests for predicting reading achievement.

This would indicate that the first three subtests measure factors which although significantly correlated with reading achievement, are not represented in reading achievement at the end of first grade.

As was suggested in the description of the subtests of the Illinois Test of Psycholinguistic Abilities, the tests at the automatic-sequential level, particularly the visual-motor sequential and the auditory-vocal sequential, appear to be measuring several other processes besides the process of sequencing. Even though these processes may correlate with reading achievement, they are not essential to the reading process. By having a negative weight, subtest

four, visual-motor association, suppresses these processes for purposes of prediction.

Subtest two, visual decoding, when included in the context of the significant predictors, significantly contributes to the variance of prediction. It contributes 4.22% of the variance giving a cumulative total of 81.06% of variance.

The remaining subtests do not significantly contribute to the prediction of reading achievement at the end of first grade.

In summary, the rank order of subtests that contribute significantly to prediction of achievement on the word recognition test is: subtests 9, 8, 7, 4 and 2. Although subtest nine contributes most to the per cent of variance, inclusion of each subtest significantly increases the per cent of variance.

Table VI also indicates that subtests nine and eight are the best predictors of sentence reading, paragraph reading, and total reading scores. Suppression variable subtest four ranks third. Subtest two ranks fourth, and subtest seven reappears as fifth on predicting total reading score.

The data, therefore, indicate that the subtests at the automatic-sequential level and the visual-motor association and visual decoding subtests, which appear to be somewhat similar, are the best predictors of reading achievement at the end of first grade.

Predicting Reading Achievement with Individual Subtest Scores, Plus the Total Score of the Illinois Test of Psycholinguistic Abilities

Inclusion of the total I.T.P.A. score within the context of the individual subtest scores as predictors of reading achievement

did not change the rank order of the predictors, nor the per cent of variance for each predictor. The total I.T.P.A. score did not even approach significance as a predictor of reading achievement.

This indicates that the total test score is completely redundant in this context. This could be expected since it is simply the summation of the individual subtest scores.

Predicting Reading Achievement with the Individual Subtest Scores, Plus the Total Score, Plus the Score of Groupings of the Subtests

The subtests of the I.T.P.A. could be grouped into theoretical groupings according to level of organization (automatic-sequential level and representational level), process (decoding, association, and encoding), and channel of communication (visual-motor and auditory-vocal).

It was hypothesized that either one of these groupings may be more significant as predictors of reading achievement than some of the individual subtests or groupings. For example, it is not unreasonable to expect the visual-motor channel to be more significant in predicting reading achievement than is the auditory-vocal channel since reading is primarily a visual task.

Scores of groupings of the individual subtests, like the total I.T.P.A. score, were redundant and did not change the rank order of individual subtests as predictors, nor did they affect the per cent of variance contributed by the significant individual subtest scores as predictors of reading achievement. Scores of groupings did not even approach significance. Therefore within the context of individual

subtest scores and the total I.T.P.A. score, the score of groupings of individual subtests doesn't contribute to the prediction of reading achievement at the end of first grade.

Summary of Finding When Predicting Reading Achievement with Achievement on the Illinois Test of Psycholinguistic Abilities

The data show that the rank order of contribution of the scores of the subtests in predicting achievement on the word recognition test is: subtests 9, 8, 7, 4 and 2, with subtest 4 acting as a suppression variable.

The data also show that the rank order of contribution of the subtest scores in predicting the sentence reading, paragraph reading and total reading scores is: subtests 9, 8, 4, 2 and 7, with subtest 4 again acting as a suppression variable.

The total I.T.P.A. score, and the score of theoretical groupings of subtests were found to be redundant and did not contribute to prediction of reading achievement. They left the individual subtest as the significant predictors in the same rank order and contributing the same per cent of variance as they were before the total score and the score of groupings were introduced into the context of predictors.

The total I.T.P.A. score, and the score of groupings of individual subtests were therefore not included in any further analysis.

Predicting Reading Achievement with the Scores of the Individual Subtests in the Context of I.Q., Mental Age, and Socio-economic Status

It has previously been shown that I.Q., mental age, and socio-economic status correlate significantly at the .01 level with reading

achievement. It has also been shown that these three factors affect achievement on the I.T.P.A. It was therefore postulated that if they were included in the context of scores of the individual I.T.P.A. sub-scores as predictors, the rank order of predictors would be altered.

To test this postualte, a step wise multiple linear regression analysis of the data was carried out. The results are presented in Table VII.

The data in Table VII indicate that inclusion of I.Q., mental age, and socio-economic status in the context of predictors does alter the rank order of predictors of reading achievement.

With the word recognition test as criterion, socio-economic status now ranks fifth, and subtest 2 (visual decoding) drops to sixth position. The order of the first four predictors remains the same, and the per cent of variance contributed by each is also unchanged. Subtest 4, visual-motor association, still functions as a suppression variable.

Since the order of the first four predictors remains the same, and the fifth still remained significant even though it dropped to sixth position, it was concluded that the effect of the three new variables is minimal in predicting achievement on the word recognition test.

As shown in Table VII, on sentence reading, paragraph reading and total reading score prediction, I.Q. moves to second position with subtest 9 still the largest predictor. Subtest 8 now occupies third

TABLE VII

PREDICTING READING ACHIEVEMENT WITH SCORES OF INDIVIDUAL SUBTESTS OF THE ILLINOIS TEST OF PSYCHOLINGUISTIC ABILITIES, PLUS I.Q., PLUS MENTAL AGE, PLUS SOCIO-ECONOMIC STATUS

Criterion	Ranked Predictors	% of Variance	Cumulative Variance	t(.01)
Word Recognition	(9) V-m Sequential	48.77		
	(8) A-V Sequential	14.16	62.93	9.17
	(7) A-V Automatic	6.09	69.02	4.52
	*(4) V-m Association	7.82	76.84	7.43
	Socio-economic status	6.16	82.99	7.60
	(2) Visual Decoding	2.14	85.14	2.88
Sentence Reading	(9) V-m Sequential	55.09		
	I.Q.	13.48	68.57	10.29
	(8) A-V Sequential	3.73	72.30	3.09
	Socio-economic status	3.98	76.27	3.69
Paragraph Reading	(9) V-m Sequential	43.57		
	I.Q.	10.07	57.65	7.89
	(8) A-V Sequential	6.69	64.34	4.32
Total Reading Score	(9) V-m Sequential	54.51		
	I.Q.	11.70	66.21	8.31
	(8) A-V Sequential	7.83	74.04	6.94
	*(4) V-m Association	4.51	78.56	4.63

*Subtest 4, Visual-Motor sequential association, has a negative weight.

position with socio-economic status as suppression variable in predicting sentence reading achievement, and subtest 4 as suppression variable in predicting total reading scores.

It would therefore appear that the three variables, I.Q., mental age, and socio-economic status, when introduced into the context of prediction, have minimal effect in predicting achievement on the word recognition test.

However, in predicting reading achievement beyond word recognition, I.Q. became a significant and powerful predictor occupying second position in the rank order.

SUMMARY

This chapter has presented the findings of the data analysis. Five of the nine subtests of the I.T.P.A. were found to be significant predictors of reading achievement. The rank order of subtests as predictors was relatively stable. Total I.T.P.A. score, and the scores of groupings of subtests were redundant and did not contribute to the prediction of reading achievement. They left the rank order and the contribution of each subtest intact.

Since three other variables were significantly correlated with reading achievement, and affected achievement on the I.T.P.A., it was postulated that inclusion of these three variables within the context of the predictors would alter the rank order of the predictors. The rank order of predictors of achievement on the word recognition test was minimally altered at the end of the order. The rank order of predictors was considerably altered in predicting sentence reading, paragraph reading, and total reading scores.

CHAPTER VI

SUMMARY, CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

The present study was designed to test the hypothesis that achievement on the Illinois Test of Psycholinguistic Abilities will not predict reading achievement at the end of the first grade.

The sample of 27 children was randomly selected from the population within six schools in the Edmonton Public School District. The Illinois Test of Psycholinguistic Abilities was administered in September, 1966. The Gates Primary Reading Tests were administered to the children in the sample during the month of May, 1967.

A step wise multiple linear regression analysis of the data was carried out to determine the rank order in effectiveness of scores and of the subtests of the I.T.P.A., total I.T.P.A. score, and the score of theoretical groupings of subtests in predicting reading achievement.

It was also postulated that since I.Q., mental age, and socio-economic status were significantly correlated with reading achievement, and affect achievement on the I.T.P.A., they would alter the rank order of the predictors of reading achievement. They were, therefore, later included in the context of predictors, and another step wise multiple linear regression analysis of the context was carried out.

In the present chapter, the conclusions are presented in terms of their relationship to the hypotheses and to the postulate. A

discussion of the limitations is presented next. This is followed by a review of possible implications of the findings and recommendations for further research.

CONCLUSIONS

Hypothesis One

The individual subtest scores of the Illinois Test of Psycholinguistic Abilities in the context of all such subtest scores do not account for a significant part of the variance attributed to the scores of the three subtests and the total score of the Gates Primary Reading Test.

The significant rank order in effectiveness of the scores of subtests of the I.T.P.A. in predicting achievement on the word recognition test was: subtest 9 (visual-motor sequential), subtest 8 (auditory-vocal sequential), subtest 7 (auditory-vocal automatic), subtest 4 (visual-motor association), and subtest 2 (visual decoding). Subtest nine accounted for approximately one half of the variance. Subtest four was a suppression variable indicating that the first three subtests also measure factors which are not represented in reading, even though they significantly correlate with reading achievement.

The significant rank order of subtest scores in predicting sentence reading was: subtest 9, subtest 8, subtest 4, and subtest 2. Subtest 4 again acted as a suppression variable. This rank order was maintained in predicting total reading score. Paragraph reading scores were predicted by subtests 9 and 8.

In view of these findings the null hypothesis is rejected. However since the number of subtest scores that predict reading

achievement varies from five to two, the hypothesis cannot be totally rejected. The hypothesis appears to be too gross to be totally accepted or rejected.

On the basis of the findings it was concluded that reading does involve the processing of non-conceptual data to give meaning to words. From analysis of the non-conceptual tests at the automatic-sequential level we may conclude that visual discrimination of letters or groups of letters, memory for sequence of letters, ability to hold a gestalt against distraction, auditory discrimination of sounds, memory for sequence of sounds, and awareness of patterns in language appear to be the factors related to processing of non-meaningful data. These factors also appear to be most significant in word recognition which also requires functioning at the conceptual level.

The processing of non-conceptual data becomes less important when considering the total reading process. Although functioning at this non-conceptual level is still significant, functioning at the conceptual level becomes more significant. When included in the context of predictors the prominence of I.Q. as a predictor of reading achievement would indicate that verbal ability is a significant factor in reading.

The data indicate that the automatic-sequential tests of the I.T.P.A. are significant predictors of reading achievement at the end of first grade. An analysis of the visual-motor sequential test, which was the most significant predictor, suggested it appears to be measuring several processes. Two processes this test may be measuring

may be memory for sequence of letters, and ability to hold a gestalt against distraction.

The presence of the suppression variable, which is believed to be a conceptual variable, would tend to support the suggestion that non-conceptual processes are being measured by the visual-motor sequential test and are critical in predicting achievement on the word recognition test.

As has been stated before, word recognition does not necessarily proceed in the orderly sequential manner of the tasks on the sequential tests. Often, either the total configuration, or individual letters or clusters of letters within the configuration provide the cue to the meaning of the word. Since these letters occupy a position within the spatial confines of the word, it may be a spatial factor that is critical in predicting the word recognition score. This spatial factor would most likely be a rather complex one. As has been suggested above, it may include memory for sequence, that is, memory of the relative position in space of several letters, and holding this sequence against distraction. It has also been suggested that the whole sequence may not always be important, but just a letter or cluster of letters within a larger spatial configuration may be critical. Whatever this spatial factor may be, it appears to be complex.

Smith[79] has suggested that spatial ability may be the non-conceptual equivalent of verbal ability. This study may tend to support this suggestion.

The first three ranked predictors of achievement on the word recognition test make up the automatic-sequential level of the I.T.P.A. This tends to support Bateman's[80] statement that reading involves the somewhat mechanical processing of non-conceptual material. It also tends to support her conclusions that continued emphasis should be placed on the mechanical rather than the meaningful aspects of reading. Bateman's conclusions were based on her finding a relationship between the automatic sequential level subtests and reading achievement. However, she did not include other variables as predictors and assumes that the subtests of the I.T.P.A. measure what they purport to measure. The findings of this study indicate that processing of non-conceptual material is required in reading, but is more important in word recognition than in the total reading process. Furthermore, it was found that functioning at the conceptual level is also required in reading. Since it also suggested that the tests at the automatic sequential level may be measuring a spatial factor rather than a purely mechanical process reading may not be as mechanical a process

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[79] I. M. Smith, Spatial Ability (London: University of London Press, 1964).

[80] B. D. Bateman, "Reading and Psycholinguistic Processes of Partially Seeing Children," Selected Studies on the Illinois Test of Psycholinguistic Abilities (Urbana, Illinois: Institute for Research on Exceptional Children, University of Illinois, 1966) (in Test Kit).

as suggested by Bateman. This would indicate that her conclusion is unwarranted.

In summary, it was concluded that reading requires the processing of non-conceptual data as well as conceptual data. It was suggested that functioning at the non-conceptual level may be a spatial ability factor, and that reading consists of a spatial and a verbal factor.

It was also suggested that any conclusions as to emphasis in teaching reading that are based on achievement on the I.T.P.A. are unwarranted.

Hypothesis Two

The total score of the Illinois Test of Psycholinguistic Abilities in the context of the subtest scores and the total score of the Illinois Test of Psycholinguistic Abilities does not account for a significant part of the variance attributed to the scores of the three subtests and the total score of the Gates Primary Reading Test.

Within the context of the individual subtest scores, the total I.T.P.A. score is redundant and does not contribute to prediction of reading achievement. Inclusion of the total I.T.P.A. score did not alter the rank order of subtest scores in predicting reading achievement, nor did it alter the per cent of variance contributed by each subtest score. In other words, when we know the scores of the subests, our ability to predict reading achievement is not improved by knowing the total I.T.P.A. score.

Hypothesis two is therefore accepted.

Hypothesis Three

The scores of theoretical groupings of subtests of the Illinois Test of Psycholinguistic Abilities in the context of such groupings plus individual subtest scores do not account for a significant part of the variance attributed to the score of the three subtests and the total score of the Gates Primary Reading Test.

The data shows that in the context of the nine individual subtest scores, plus the total I.T.P.A. score, the scores of groupings of individual subtests were redundant and did not contribute to prediction of reading achievement. The rank order of predictors, and their contribution to the per cent of variance remained as they were when the context contained only the scores of individual subtests. In other words, when we know the scores on the individual subtests, knowing the scores of theoretical groupings of subtests does not improve our ability to predict reading achievement. Hypothesis three is therefore accepted.

However, when we examine the data related to hypothesis one, we find that the first three subtests in the rank order of predictors of achievement on the word recognition test are the subtests at the automatic-sequential level. We may, therefore, conclude that the automatic-sequential level is a significant predictor of achievement on the word recognition test. This, however, does not provide additional information since we already know the scores on the individual subtests.

General Conclusions

From the findings of this study it was concluded that processing of non-conceptual and conceptual material is required in reading. It was suggested that the visual-motor sequential subtest may be measuring a factor other than what it purports to measure. It was also suggested that this factor may be spatial ability.

It was also suggested that conclusions as to emphasis in teaching reading that are based on performance on the I.T.P.A. are unwarranted.

From the findings it is concluded that the use of the Illinois Test of Psycholinguistic Abilities is a predictor of reading achievement at the end of the first grade is inadvisable. Only five of the nine subtests were significant predictors of reading achievement, and this included one subtest that acts as a suppression variable. However, when I.Q. was included in the context of predictors, it ranked above four of the five subtests as predictors. The presence of the suppression variable indicates that the tests at the automatic-sequential level which were the significant predictors are also measuring factors not found in reading. Since these subtests measure factors not represented in reading, I.Q. is a better predictor than eight of the nine subtests; and the test requires approximately one and one-half hours to administer to only one student; other tests which are not as complex or lengthy and whose predictive validity have been established would be preferred to the I.T.P.A. as predictors of

reading achievement. deHirsch, Jansky and Langford[81] suggest some reading readiness tests which would be preferred to the I.T.P.A.

Eller[82] questions whether the three Gates Primary Reading Tests measure three relatively different abilities, and suggests that they should be considered as three parts of a single test. The change in the rank order of predictors with and without I.Q. being included in the context of predictors would indicate that they are measuring different aspects of reading.

The most noticeable difference occurs when we compare predictors of scores on the word recognition test, and predictors of the other test scores. This would indicate that at least two different abilities are being measured.

The findings of this study also indicate that achievement on the I.T.P.A. is affected by mental age, I.Q., socio-economic status, and sex. However, examination of these variables in relation to the sample suggests that I.Q. may be the central factor. Validity studies on the I.T.P.A. did not find I.Q. a factor affecting achievement on the I.T.P.A. but the validity studies excluded subjects with I.Q. over 120. Several of the subjects in the sample of this study had an I.Q. over 120.

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[81] Katrina deHirsch, J. J. Jansky and W. S. Langford, Predicting Reading Failure (New York: Harper and Row, 1966).

[82] Eller, op. cit., p. 1063

LIMITATIONS

The results of this study must be viewed in the light of certain limitations. These are concerned with the size of the sample, and the conditions under which two processes described as being equivalent are measured.

The final sample of twenty-seven subjects is somewhat small in relation to the number of variables being considered. However, enough degrees of freedom were provided to enable significant predictions to occur. Furthermore, using the .01 level of confidence further minimizes the possibility of chance relationships.

The reading process has been described as a psycholinguistic process, and equivalence between psycholinguistic processes in reading and psycholinguistic processes measured by the Illinois Test of Psycholinguistic Abilities was suggested. This equivalence has been substantiated to a certain degree, particularly at the automatic-sequential level. The presence of the suppression variable indicates that the processes measured by the tests at the automatic-sequential level include factors not represented in the reading process. Failure to establish greater equivalence between these two processes may be partially due to measurement of processes of reading as integrated processes in the context of the reading act, while the processes measured by the I.T.P.A. are isolated and measured outside the context of the reading act.

IMPLICATIONS

The results of a study such as this may prove useful to persons concerned with children's readiness for reading. Table VIII presents the I.T.P.A. subtests that were significant predictors of reading achievement at the end of the first grade, and an analysis of these subtests, which indicates the processes that they may be measuring.

An examination of Table VIII indicates that auditory-discriminations, short term auditory memory of a sequence, visual discrimination, short term visual memory of a sequence, ability to hold a visual gestalt against distraction, and awareness of redundancies in language, and classification of objects according to different criteria are related to reading achievement.

Although administration time of the I.T.P.A. may be too lengthy for general classroom use, attention to the factors named above may aid the teacher in determining children's readiness for reading. Areas of weakness may also indicate the type of individualized work required by that child.

The results of this study also indicate that the factors related to readiness for reading should not be considered in isolation, but within the context of the various factors related to reading achievement. It has been shown that as the context of the predictors changes, so does the predictive effectiveness of each variable.

TABLE VIII

AN ANALYSIS OF THE SUBTESTS THAT WERE SIGNIFICANT PREDICTORS OF READING ACHIEVEMENT AT THE END OF FIRST GRADE

Subtest Number	Name	Process Probably Being Measured
9	Visual-Motor Sequential	-Visual discrimination -A general spatial factor believed to be partly composed of (a) short term memory for visual sequence (b) ability to hold a visual gestalt or visual sequence against distraction
8	Auditory-Vocal Sequential	-Auditory discrimination -Auditory blending -Short term memory of aural sequence
7	Auditory-Vocal Automatic	-Auditory discrimination -Auditory blending -Awareness of redundancies in the language
4	Visual-Motor Association	-Visual discrimination -Ability to classify objects according to various criteria -Ability to inter-relate above classes
2	Visual Decoding	-Visual discrimination -Ability to classify objects according to various criteria

Furthermore, Barritt, Semmel and Weener[83] have shown that large growth scores in psycholinguistic functioning occur at the first grade level, but do not follow any consistent pattern. Therefore, concentration on one factor in isolation rather than within the context of other factors related to reading readiness may result in an unnecessary delay and in wasted effort.

SUGGESTIONS FOR FURTHER RESEARCH

In general, further research is necessary to determine the relationship of factors measured by the sequencing subtests to reading achievement. This is indicated by the sequencing subtests consistently being significant predictors of reading achievement. However, the description of the two subtests in Chapter II of this study indicated that several factors were being measured by these subtests. It was also suggested that they may be measuring spatial ability. Frequent appearance of the suppression variable would indicate that some of the factors measured by the sequencing subtests are not represented in reading as measured by the Gates Primary Reading Tests. Furthermore, several of the factors measured by the sequential tests, such as auditory and visual discrimination, are known to be related to reading achievement. Therefore, further research is necessary to determine what factors are measured by the sequencing subtests and

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[83] S. Barritt, M. I. Semmel, and P. D. Weener, "The Changes in Psycholinguistic Functioning of Children after One Year in an Integrated School," (University of Michigan: Center for Research on Language and Language Behavior, 1967). (Mimeographed.)

their relationship to reading achievement. More specifically, it may be desirable to determine:

1. The relationship of memory for a visually presented sequence to reading achievement. A study may be done where discrimination is minimized by using stimuli familiar to children, and also using non-conceptual stimuli where only very gross discriminations are necessary.

Use of familiar stimuli arranged in a sequence which represents language usage would indicate the relationship of memory of a sequence of meaningful material to reading achievement. Use of non-conceptual stimuli would indicate the relationship of memory of a sequence of non-conceptual material to reading achievement. Comparison of the two would indicate their relative importance in predicting reading achievement, and would also give further evidence as to the relationship of memory of sequence to reading achievement.

2. The relationship of holding a visual gestalt against distraction to reading achievement. The stimuli suggested above would test the holding of a gestalt composed of meaningful and non-conceptual stimuli. A comparative analysis would also be indicated.

3. The relationship of various other spatial tests to reading achievement. This would be an attempt to determine the factors that may compose the suggested complex factor.

4. The relationship of memory for auditorily presented sequence to reading achievement. Several types of stimuli could be utilized. Digits as are currently being used are meaningful but do not form a meaningful sequence. Stimuli using a sequence of

pseudo words which resemble words of the language would test memory for a sequence of sounds familiar to the child but forming a non-meaningful sequence composed of non-meaningful units. Also meaningful words arranged in meaningful sequences of varying length would provide completely meaningful stimuli. Table IX shows the organization of stimuli according to units and sequence.

TABLE IX

AUDITORY STIMULI USED FOR AUDITORY SEQUENCING TESTS

Stimulus	Unit	Sequence
pseudo words	non-meaningful	non-meaningful
digits	meaningful	non-meaningful
words	meaningful	meaningful

The results would indicate not only the relationship of memory for sequencing of auditory stimuli to reading achievement, but also the effectiveness of each type of unit and sequence in predicting reading achievement.

The findings of this study showed that the visual-motor sequencing subtest consistently accounted for approximately one half the variance of prediction of reading achievement. It has been suggested that this subtest measures such factors as visual discrimination, classification of objects, memory for sequence of visual stimuli, ability to hold a gestalt against distraction, and spatial orientation.

The first two variables are known to be related to reading achievement. It was therefore suggested that further research be carried out to determine the relationship and their relative importance of the latter three variables to reading achievement.

SUMMARY

The present study was designed to investigate the hypothesis that the various scores of the Illinois Test of Psycholinguistic Abilities within the context of all the scores will not predict reading achievement as measured by the Gates Primary Reading Tests at the end of first grade.

The sample for the study consisted of twenty-seven school beginning children randomly selected from a population of six schools in the Edmonton School District.

The Illinois Test of Psycholinguistic Abilities was administered in September, and the criterion, Gates Primary Reading Tests, was administered in May. A step wise multiple linear regression analysis of the data was carried out. Both the I.T.P.A. and the reading tests were analyzed.

It was concluded that achievement on the I.T.P.A. is affected by I.Q., mental age, socio-economic status and sex. Analysis of data also led to the conclusion that within the context of the nine subtests, five subtests significantly predicted reading achievement. Three subtests measured non-conceptual processes, and two subtests measured conceptual processes. It was therefore concluded that reading requires the processing of non-conceptual and conceptual data.

The total I.T.P.A. score, and theoretical groupings of subtest scores were found to be completely redundant, and did not contribute to the prediction of reading achievement.

It was also concluded that the Gates Primary Reading Tests measure more than one different process of reading.

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APPENDICES

APPENDIX A. The Illinois Test of Psycholinguistic Abilities

THE ILLINOIS TEST OF PSYCHOLINGUISTIC ABILITIES

Record Form for the Experimental Edition

Name _____ Sex _____ Examiner _____

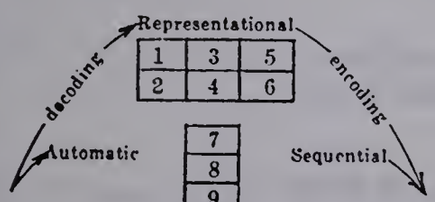
Birthdate _____ Date of test _____ CA _____

Intelligence test (verbal) _____ Date of test _____ CA _____ MA _____ IQ _____

Intelligence test (performance) _____ Date of test _____ CA _____ MA _____ IQ _____

Other tests _____

Test Summary	Raw Score	Language Age	Standard Score	Profile Test Numbers
Auditory-Vocal Automatic Test				7
Visual Decoding Test				2
Motor Encoding Test				6
Auditory-Vocal Association Test				3
Visual-Motor Sequencing Test				9
Vocal Encoding Test				5
Auditory-Vocal Sequencing Test				8
Visual-Motor Association Test				4
Auditory Decoding Test				1
ITPA Total				



MA Verbal	MA Perform.	Other Tests	ITPA Total	CA	REPRESENTATIONAL LEVEL						AUTOMATIC-SEQUENTIAL			SS
					Decoding		Association		Encoding		Automatic	Sequential		
					1	2	3	4	5	6	7	8	9	
					Auditory	Visual	Auditory Vocal	Visual Motor	Vocal	Motor	Auditory Vocal	Auditory Vocal	Visual Motor	
				9-0										+3.00
				8-6										+2.50
				8-0										+2.00
				7-6										+1.50
				7-0										+1.00
				6-6										+ .50
				6-0										.00
				5-6										- .50
				5-0										-1.00
				4-6										-1.50
				4-0										-2.00
				3-6										-2.50
				3-0										-3.00
				2-6										

Aided by a grant from the United Cerebral Palsy Research and Educational Foundation and the Grotto Humanitarian Foundation.

Auditory-Vocal Automatic Test

1 _____
2 _____
3 _____
4 _____
5 _____
6 _____
7 _____
8 _____
9 _____
10 _____
11 _____
12 _____
13 _____
14 _____
15 _____
16 _____
17 _____
18 _____
19 _____
20 _____
21 _____
22 _____

Score

Visual Decoding Test

1 _____
2 _____
3 _____
4 _____
5 _____
6 _____
7 _____
8 _____
9 _____
10 _____
11 _____
12 _____
13 _____
14 _____
15 _____
16 _____
17 _____
18 _____
19 _____
20 _____
21 _____
22 _____
23 _____
24 _____

Score

Motor Encoding Test

1 TOY GUN: Points and pulls trigger._____

2 TOY PITCHER: Pours._____

3 PENCIL SHARPENER: Holds pencil and turns._____

4 TROMBONE: Blows._____
Holds; slides with other hand._____

5 DRILL: Holds; turns with other hand._____

6 TELEPHONE: Dials._____
Puts receiver to ear._____

7 SAFE: Turns combination._____

8 DOOR KNOB: Grasps and turns. _____
Pulls or pushes._____

9 SAW: Back and forth motion._____
Holds board with other hand._____

10 BINOCULARS: Cupped hands to eyes._____
Turns head to scan._____

11 FUNNEL: Pours into._____
Cups other hand for funnel._____

12 STETHOSCOPE: Plugs in ears and listens to heart._____

13 SAXOPHONE: Blows and fingers._____

14 GUITAR: Holds and strums._____
Fingers._____

15 FLUTE: Holds properly._____
Blows._____
Fingers._____

16 VIOLIN: Fingers._____
Arm support and bows._____
Chin support._____

Score

Auditory-Vocal Association Test

1	_____	14	_____
2	_____	15	_____
3	_____	16	_____
4	_____	17	_____
5	_____	18	_____
6	_____	19	_____
7	_____	20	_____
8	_____	21	_____
9	_____	22	_____
10	_____	23	_____
11	_____	24	_____
12	_____	25	_____
13	_____	26	_____

Score ☐

Visual-Motor Sequencing Test

		Trial 1	Trial 2
1.	bed - telephone	____	____
2.	hammer - pencil	____	____
3.	cat - potato - dog	____	____
4.	s—s—3	____	____
5.	s—3—o	____	____
6.	o—s—d—d	____	____
7.	s—s—8—d	____	____
8.	d—8—d—z	____	____
9	3—z—d—8	____	____
10.	8—d—z—6	____	____
11.	z—3—z—d—o	____	____
12.	d—3—8—z—8	____	____
13.	d—z—6—3—d	____	____
14.	3—5—8—d—d—z	____	____
15.	3—6—8—d—5—z	____	____

Score ☐

Vocal Encoding Test

1. Ball ☐	name rolls bounces color throw	
2. Chalk ☐	name writes color blackboard rolls	
3. Block ☐	name color square build with wood	
4. Celluloid ☐	transparent flexible plastic square glass	

Score ☐

Auditory-Vocal Sequencing Test

		Trial 1	Trial 2
1.	1—2		
2.	9—6		
3.	5—2—1		
4.	6—8—9		
5.	9—7—6		
6.	4—3—4		
7.	6—6—1—1		
8.	6—3—5—8		
9.	4—4—2—4		
10.	5—7—4—5		
11.	2—5—4—9—9		
12.	6—1—6—3—7		
13.	4—5—9—1—4		
14.	9—1—7—5—3—3		
15.	8—9—6—3—4—8		
16.	6—3—9—7—3—5		
17.	6—9—2—8—7—9		
18.	3—8—9—1—7—5—5		
19.	6—4—5—5—8—4—1		
20.	8—2—9—4—7—5—3		

Score

Visual-Motor Association Test

1 _____
2 _____
3 _____
4 _____
5 _____
6 _____
7 _____
8 _____
9 _____
10 _____
11 _____
12 _____
13 _____
14 _____
15 _____
16 _____
17 _____
18 _____
19 _____
20 _____
21 _____
22 _____
23 _____
24 _____
25 _____
26 _____
27 _____
28 _____

Score

Auditory Decoding Test

1 _____
2 _____
3 _____
4 _____
5 _____
6 _____
7 _____
8 _____
9 _____
10 _____
11 _____
12 _____
13 _____
14 _____
15 _____
16 _____
17 _____
18 _____
19 _____
20 _____
21 _____
22 _____
23 _____
24 _____
25 _____
26 _____
27 _____
28 _____
29 _____
30 _____
31 _____
32 _____
33 _____
34 _____
35 _____
36 _____

Score

APPENDIX B. The Gates Primary Reading Test

GATES PRIMARY READING TEST

TYPE PWR

FORM 1

For Grade 1 and Grade 2 (First Half)

Type PWR. Word Recognition

BUREAU OF PUBLICATIONS • TEACHERS COLLEGE • COLUMBIA UNIVERSITY
525 West 120th Street, New York 27, N. Y.

Write your name here.....

How old are you?..... When is your birthday?.....

School..... Grade..... Date.....

1. 

did egg

dog two

2. 

be bed

bag she

3. 

may make

come milk

4. 

horse play

hose house

To the teacher: Detailed instructions for administering and scoring this test are given in the Manual (included in each test package).

Number correct..... Number wrong..... Raw score (correct minus ⅓ wrong).....

Number tried.....(possible 48) Reading grade..... Reading age.....

Be sure to signal STOP at the end of 15 minutes.

Printed in U.S.A.

1. 

bed bag

fly not

2. 

red put

cow can

3. 

boy bat

pan get

4. 

just lunch

jump sheep

5. 

coat cook

book hat

6. 

mitten kitchen

knife kitten

7. 

pony play

your say

8. 

sea sun

ten fan

9. 

keep sleds

sleep trees

10. 

not nut

now put

11. 

four were

bear fire

12. 

garden geese

garage poison

13. 

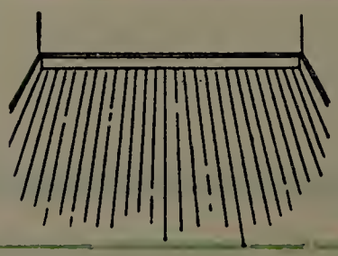
read hide

rain ride

14. 

water watch

paper gates

15. 

coat door

flower floor

16. 

lettuce better

letter little

17. 

pencil piano

penny funny

18. 

check lunch

child church

19. 

funny fairy

softly family

20. 

winds window

winter throw

21. 

fruit from

suit fresh

22. 

red sea

see he

23. 

turkey turtle

turned monkey

24. 

let out

pig leg

25. 

face from

hard farm

26. 

shop shot

drop stop

27. 

play start

star rats

28. 

cock rock

root clock

29. 

potato porridge

tortoise pancake

30. 

going liking

wanting good

31. 

ten pan

paint than

32. 

take rats

rake lake

33. 

sail nest

mail nail

34. 

sleep sheep

ships shine

35. 

south teeth

teach teeny

36. 

smell smile

smoke sell

37. 

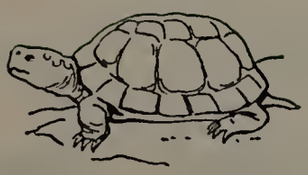
climb class

limb clean

38. 

store stick

story more

39. 

turkey monkey

turtle trouble

40. 

band store

start stand

41. 

brick stick

break bridge

42. 

neat neck

need deck

43. 

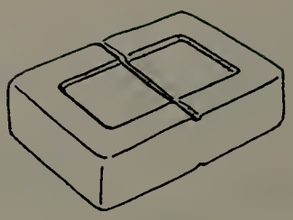
plant skate

plate plane

44. 

wagon waves

wigwam without

45. 

rope soup

some soap

cocoa corner

cover river

47. 

land limb

lamp lamb

48. stop

wore word

lord wood

GATES PRIMARY READING TEST

TYPE PSR

FORM 1

For Grade 1 and Grade 2 (First Half)

Type PSR. Sentence Reading

BUREAU OF PUBLICATIONS • TEACHERS COLLEGE • COLUMBIA UNIVERSITY
525 West 120th Street, New York 27, N. Y.

Write your name here.....

How old are you?.....When is your birthday?.....

School.....Grade.....Date.....

This is a boy. I

This is a girl. II

This is a box. III

The girl has a book. I

The box is on the bed. II

The cat has a ball. III

To the teacher: Detailed instructions for administering and scoring this test are given in the Manual (included in each test package).

Number tried.....(possible 45) **Raw score (number of sentences correct).....**

Reading grade..... **Reading age.....**

Be sure to signal STOP at the end of 15 minutes.

Printed in U.S.A.

This is a balloon. I

This is a butterfly. II

This is a bear. III

This is a Christmas tree. I

Here are apples and oranges. II

Mother is talking with grandma. III

This is a book. I

This is a fan. II

This is an Indian. III

Father is mending the gate. I

This apple is sweet. II

The snow is melting. III

The child is flying a kite. I

The lunch is in the basket. II

This dress is black. III

The children like the snow. I

The moon is full and round. II

The train is moving. III

Here is a brave policeman. I

This monkey has some fruit. II

This airplane is big. III

Mother is pressing a dress. I

The engine pulls the train. II

The music is on the piano. III

This is a box of candy. I

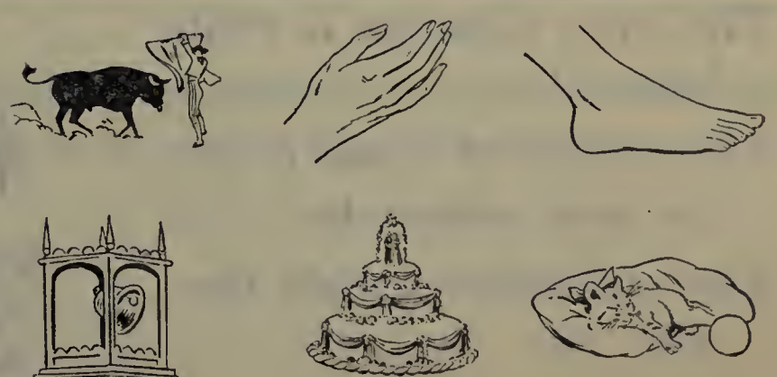
This picture shows an arm and a hand. II

This roof needs mending. III

This is an angry, dangerous beast. I

This picture shows a hand and five fingers. II

The bell is ringing. III



The wood-cutter chops down the tree. I

This handkerchief is made of cotton. II

There is cream in this pudding. III

The children like ice cream. I

The house is on fire. II

The berries are in a saucer. III

Here is a fine reindeer. I

This monkey is in a cage. II

The factory has a whistle. III

The soldier starts on a journey. I

She is a happy, jolly playmate. II

The lovely queen has several servants. III

The king rides on a white horse. I

This bunch of roses is for the sick nurse. II

The old miller grinds the corn. III

GATES PRIMARY READING TEST

TYPE PPR

FORM 1

For Grade 1 and Grade 2 (First Half)

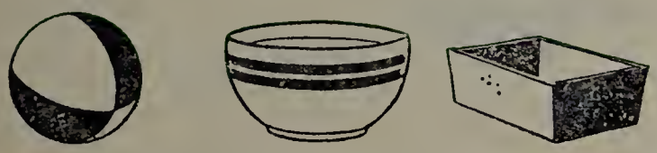
Type PPR. Paragraph Reading

BUREAU OF PUBLICATIONS • TEACHERS COLLEGE • COLUMBIA UNIVERSITY
525 West 120th Street, New York 27, N. Y.

Write your name here.....

How old are you?.....When is your birthday?.....

School.....Grade.....Date.....



1. Put an X on the ball.

2. Put an X on the milk bottle.

3. Draw a line under the little book.

4. Draw a line from the pig to the tree.

To the teacher: Detailed instructions for administering and scoring this test are given in the Manual (included in each test package).

Number tried.....(possible 26) **Raw score (number of sentences correct).....**

Reading grade..... **Reading age.....**

Be sure to signal STOP at the end of 20 minutes.

Printed in U.S.A.

1. Put an X on the man.

5 2 5

2. Put an X on the little 5.

3. Draw a line under the white dress.

4. Draw a line under the dog that is sleeping.

5. Put an X on one of the kittens.

6. Put an X on the big dog with the bone.

7. Put an X on the boat.

8. Draw a line under the dark cloud in the sky.

9. Draw a line under the tiny bear.

10. Put an X on the big ship at sea.

11. Put an X on the dog which is leaping through the hoop.

12. The father told the boy to put his pony in the barn. Draw a line from the pony to the barn.

drum drum drum

13. Here are three ways of writing "drum." Draw a line under the one you think is good writing.

14. A teacher told the boy to jump into the water for the ball. Draw a line from the boy to the ball.

15. Here are some toys for children. Draw a line under one toy that you think most girls would like best.

16. One of these three things can take you to camp. Draw a line under it.

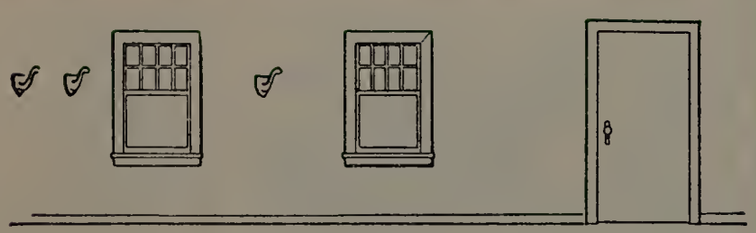
17. What would a little boy put on to go sledding? Put an X on what the little boy would put on.

18. These boys are at their school picnic. They are running a race. Draw a line around the one who is leading in the race now.

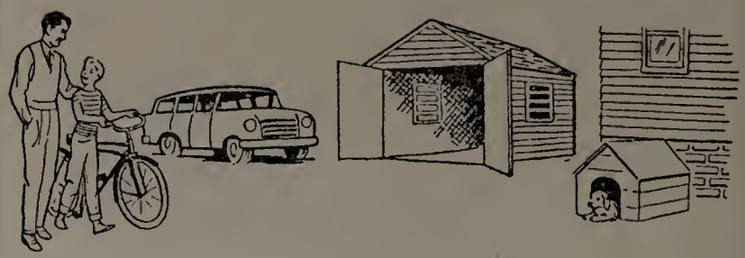
19. The campers are gathering wood. They will cook their first meal in the woods. Each night a different boy lights the fire. Draw a line under the boy who is lighting the fire.

20. It is another rainy day. The children are going to school. They came in the school bus. They have umbrellas and rubber boots. Put an X on the place they are going.

21. Our house needs to be painted. My father will paint it himself in September. Make an X on the store to which he would go to buy paint.



22. A child was told to hang his coat on the hook between the windows. Look for the place where his coat should hang, and put an X on it.



23. "Put your bicycle in the garage," said Father to the boy. Draw a line from the bicycle to the place where the bicycle may be put.

24. The guard told the children they must not go into the water when it was rough. It would not be safe. They could go swimming when it was smooth. Make an X on the picture of the water they must not go in.

25. This boy was very happy. He had saved a dollar to buy his mother a plant for her birthday. He found a store where they sold plants. Find the thing the boy had saved and mark it with an X.

26. The children had saved their pennies to build a doghouse for their puppy. While in the store, they saw some bright collars. They bought a collar instead. Draw a line under the thing the children bought.